

**EXHIBIT 8-a to PLAINTIFFS’
APPENDIX OF EXPERT REPORTS**

Confidential

Report of Professor Thomas McGuire

Regarding Public Nuisance in the Cabell Huntington Community in West Virginia

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Confidential**I. Introduction****A. Qualifications**

1. I am a Professor of Health Economics in the Department of Health Care Policy at Harvard Medical School, where I teach health economics in Harvard University's Ph.D. Program in Health Policy. In 2008, I received the Everett Mendelsohn Excellence in Mentoring Award from Harvard's Graduate School of Arts and Sciences. I received an A.B. degree from Princeton University and a Ph.D. degree in economics from Yale University.

2. I am a member of the National Academy of Medicine – formally, the Institute of Medicine (IOM) – and a Research Associate at the National Bureau of Economic Research. I served for ten years as an editor of the leading journal in the field of health economics, the *Journal of Health Economics*, and co-edited the *Handbook of Health Economics*, Volume II.

3. For more than 40 years I have conducted research on the economics of managed care, health insurance, health care payment systems, pharmaceutical drug pricing and procurement, the economics of health care disparities by race and ethnicity, and the economics of mental health policy. I have authored a series of published papers on the economics of drug prices, competition between branded and generic drug products, and insurance coverage for drugs.¹ I co-chaired four conferences on the Economics of Mental Health, sponsored by the National

¹ T.G. McGuire and S. Bauhoff, "Adoption of a Cost-Saving Innovation: Germany, UK and Simvastatin," in N. Klusen, F. Verheyen, and C. Wagner (eds.), *England and Germany in Europe – What Lessons Can We Learn from Each Other?* Baden-Baden, Germany: Nomos, 2011, pp. 11-26; E.R. Berndt, T.G. McGuire, and J.P. Newhouse, "A Primer on the Economics of Prescription Pharmaceutical Pricing in Health Insurance Markets," *Forum for Health Economics & Policy*, 14(2), 2011, Article 10; J. Glazer and T.G. McGuire, "A Welfare Measure of 'Offset Effects' in Health Insurance," *Journal of Public Economics*, 96, 2012, pp. 520-523; J. Glazer, H. Huskamp, and T.G. McGuire, "A Prescription for Drug Formulary Evaluation: An Application of Price Indexes," *Forum for Health Economics and Policy*, 15(2), 2012, Article 3; K. Drake, M. Starr, and T. McGuire, "Do 'Reverse Payment' Settlements Constitute an Anticompetitive Pay-for-Delay?" *International Journal of the Economics of Business*, 22(2), 2015, pp. 173-200; T. McGuire, *et al.*, "Resolving Reverse-Payment Settlements with the Smoking Gun of Stock Price Movements," *Iowa Law Review*, 101(4), 2016, pp. 1581-1599; K. Drake and T. McGuire, "Stock-Price Evidence for Anticompetitive Effects in the Nexium 'Reverse-Payment' Settlement," *Journal of Competition Law & Economics*, 12(4), 2016, pp. 735-747; R.S. Hartman, K.M. Drake, and T.G. McGuire, "Event Study Analysis in Cases with Multiple Brand-Generic Reverse-Payment Settlements," *International Journal of the Economics of Business*, 26(3), 2019, pp. 399-410; and K. Drake and T.G. McGuire, "Generic Entry Before the Agreed-Upon Date in Pharmaceutical Patent Settlements," working paper (https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3416632).

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Institute of Mental Health. The National Institute of Drug Abuse has sponsored my research, including research for which I served as Principal Investigator. I have published papers on the cost of drug abuse, drug abuse in the workplace, financing drug abuse services, and related topics.² My research has been recognized by a number of awards, including the Victor Fuchs Lifetime Achievement Award for 2018, awarded by the American Society of Health Economics.³

² T.G. McGuire and B. Shatkin, "Forecasting the Cost of Drug Abuse Treatment Coverage in Private Health Insurance," in Cartwright and Kaple (eds.) *Economic Costs, Cost Effectiveness, Financing and Community-Based Drug Treatment*, National Institute on Drug Abuse Research Monograph #113, 1991. D.C. Walsh, R.W. Hingston, and T.G. McGuire, "A Randomized Trial of Treatment Options for Alcohol-Abusing Workers," *New England Journal of Medicine*, 325, 1991, pp. 775-782. T.G. McGuire, C. Ruhm, and B. Shatkin, "Defining the Public Interest in Workplace Drug Abuse Policy," *National Institute on Drug Abuse Research Monograph*, 1992. T.G. McGuire and C. Ruhm, "Workplace Drug Abuse Policy," *Journal of Health Economics*, 12, 1993, pp. 19-38. R.G. Frank, T.G. McGuire, D.A. Regier, R. Manderscheid, and A. Woodward, "Paying for Mental Health and Substance Abuse Care," *Health Affairs*, 13(1), 1994, pp. 337-342. B.S. Arons, R.G. Frank, H.H. Goldman, T.G. McGuire, and S. Stephens, "Mental Health and Substance Abuse Coverage Under Health Reform," *Health Affairs*, 13(1), 1994, pp. 337-342. M. Commons, D. Hodgkin, T.G. McGuire, and M. Riordan, "Summaries of State Programs," in G. Denmead and B. Rouse (eds.), *Financing Drug Treatment Through State Programs*, Services Research Monograph No. 1, National Institute on Drug Abuse, 1994. M. Commons, D. Hodgkin, T.G. McGuire, and M. Riordan, "Paying For Drug Abuse Services in the Six New England States," in G. Denmead and B. Rouse (eds.) *Financing Drug Treatment Through State Programs*, Services Research Monograph No. 1, National Institute on Drug Abuse, 1994. R.G. Frank and T.G. McGuire, "Estimating the Costs of Mental Health and Substance Abuse Coverage for Public Policy," *Health Affairs*, 14(3), 1995, pp. 102-115. M. Commons, T.G. McGuire and M.H. Riordan, "Performance Contracting for Substance Abuse Treatment," *Health Services Research*, 32(5), 1997, pp. 631-650. M. Commons and T.G. McGuire, "Some Economics of Performance-Based Contracting for Substance-Abuse Services," in Egertson, Fox, and Leshner (eds.) *Treating Drug Abusers*, 1997, pp. 223-249. R.G. Frank and T.G. McGuire, "Savings from a Medicaid Carve-Out for Mental Health and Substance Abuse Services in Massachusetts," *Psychiatric Services*, 48(9), 1997, pp. 1147-1152. S.L. Ettner, R.G. Frank, T.G. McGuire, J.P. Newhouse, and E. Notman, "Risk Adjustment of Mental Health and Substance Abuse Payments," *Inquiry*, 35, 1998, pp. 223-239. R.G. Frank and T.G. McGuire, "Parity for Mental Health and Substance Abuse Care Under Managed Care," *The Journal of Mental Health Policy and Economics*, 1, 1998, pp. 153-159. M. Alegria, T.G. McGuire, M. Vera, G. Canino, D. Freeman, L. Matias, C. Albizu, H. Marin, and J. Calderon, "The Impact of Managed Care on the Use of Outpatient Mental Health and Substance Abuse Services in Puerto Rico," *Inquiry*, 38(4), 2001, pp. 381-965. M. Lu and T.G. McGuire, "The Productivity of Outpatient Treatment for Substance Abuse," *Journal of Human Resources*, 38(2), 2002, pp. 309-335. E. Fleming, H.-M. Lien, C.-T. Albert Ma, and T.G. McGuire, "Managed Care and Trends in Hospital Care for Mental health and Substance Abuse Treatment in Massachusetts: 1994-1997," *The Journal of Mental Health Policy and Economics*, 6, 2003, pp. 3-12. V. Ojeda and T.G. McGuire, "Gender and Racial/Ethnic Differences in Use of Outpatient Mental Health and Substance Use Services by Depressed Adults," *Psychiatric Quarterly*, 77(3), 2006, pp. 211-222. H.-M. Lien, M. Lu, C.-T. Albert Ma, and T.G. McGuire, "Progress and Compliance in Alcohol Abuse Treatment," *Journal of Health Economics*, 29 (2), 2009, pp. 213-225. E.J. Montz, T.J. Layton, A.B. Busch, R.P. Ellis, S.R. Rose, and T.G. McGuire, "Risk Adjustment Simulation: Health Plans May Have Incentives to Distort Mental Health and Substance Abuse Coverage," *Health Affairs*, 35(6), 2016, pp. 1022-1028. In addition, many of my papers refer to "mental health" or "behavioral health," terms which can include issues related to substance abuse. See my CV for other papers.

³ I was the 1981 recipient of the Elizur Wright Award from the American Association of Risk and Insurance recognizing an "outstanding contribution to the literature on risk and insurance" for my book *Financing Psychotherapy*. In 1991, I received the Carl Taube Award from the American Public Health Association for "outstanding contributions to public health." Two of my jointly authored papers received "Best Paper of the Year"

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In 2015, a jointly authored paper on reverse payment settlements in the drug industry received the Article of the Year Award from the *International Journal of the Economics of Business*.⁴

4. My litigation experience includes recent testimony at two drug industry antitrust trials.⁵ In the *National MDL Opiate Litigation*, I have submitted testimony regarding the calculation of costs due to the opioid crisis and the analysis of public nuisance for the two Ohio bellwether counties (Summit and Cuyahoga).⁶ For the State of Washington, I have also submitted written testimony regarding public nuisance.⁷ I provided deposition testimony in the Ohio matter. Appendix A contains my CV and a list of my recent testimony. Appendix B lists the materials upon which I relied and/or considered for this Report. Appendix B also notes meetings and calls in which I participated that included Cabell County Huntington Community personnel and other experts in this matter. Appendix C contains supplementary material as noted in the body of this Report.

5. My rate of compensation in this matter is \$850 per hour. I have been assisted in this matter by staff of Greylock McKinnon Associates working under my direction. I receive compensation from Greylock McKinnon Associates based on its collected staff billings in support of my work in this matter. My compensation does not depend upon the outcome of this litigation. I understand that discovery is ongoing. I reserve the right to update my analysis based on additional information.

awards in 2008, one from Academy Health for research on physician-patient interaction and one from the National Institute for Health Care Management for work on incentives in managed care plans. My paper on designing payment systems for private health insurance markets received the best paper of the year award in 2014 from the National Institute for Health Care Management.

⁴ K. Drake, M. Starr, and T. McGuire, *op. cit.*

⁵ *In re: Nexium (Esomeprazole) Antitrust Litigation*, United States District Court for the District of Massachusetts, MDL No. 2409, Civil Action No. 112-cv-11711, November 7 and 20, 2014 and *In re: Solodyn (Minocycline Hydrochloride) Antitrust Litigation*, United States District Court for the District of Massachusetts, MDL No. 14-md-2503-DJC, March 26-27, 2018.

⁶ *In re: National Prescription Opiate Litigation*, MDL No. 2804, Case No. 17-md-2804.

⁷ *State of Washington v. Purdue Pharma L.P.; et al.*, State of Washington, King County Superior Court, No. 17-2-25505-0 SEA.

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6. In their Corrected Joint and Third Amended Complaint, Cabell County and the City of Huntington (the Plaintiffs) allege:

“Defendants have created and maintained a public nuisance by marketing, distributing, selling opioids, and/or exacerbating the flood of opioids into Plaintiffs’ Community in ways that unreasonably interfere with the public health, welfare, and safety in Plaintiffs’ Community.”⁸

Throughout this Report, the “Cabell Huntington Community,” or “Community” refers to the entire community of Cabell County and the City of Huntington, the Plaintiffs.⁹

7. In connection with the public nuisance claims raised by the Plaintiffs, I have been asked the following three questions:

- First, is there a framework within the area of applied microeconomics by which economists determine the existence of, and measure the extent of, what is known under the law as a “public nuisance?”
- Second, do I have an opinion to a reasonable degree of certainty in the area of applied microeconomics as to the magnitude of the economic costs, net of any benefits,¹⁰ imposed in the Cabell Huntington Community by the sales and distribution of prescription opioid products in the Community?

⁸ Corrected Joint and Third Amended Complaint, *In re: National Prescription Opiate Litigation as it relates to Cabell County Commission and City of Huntington, West Virginia*, Case No. 1:17-op-45053-DAP (S.D. W.Va.) and Case No. 1:17-op-45054 (S.D. W.Va.), in the United States District Court for the Northern District of Ohio, Eastern Division, September 16, 2019 (hereafter Complaint), ¶ 1405.

⁹ While the majority of the City of Huntington is in Cabell County, a small portion of it is in Wayne County. In 2018, the Wayne County portion of the City of Huntington counted 3,584 residents, representing approximately 7.8% of Huntington’s total population of 45,758 residents. U.S. Census, City and Town Population Totals: 2010-2018, (<https://www.census.gov/data/tables/time-series/demo/popest/2010s-total-cities-and-towns.html>). I note in this Report where data only refer to Cabell County or the City of Huntington.

¹⁰ The empirical framework I apply in this Report recognizes and quantifies not only costs in economic terms, but potential benefits in terms of effects on workforce participation. Consideration of costs net of any benefits reflects my understanding of a “balance test” of harms and value referred to in the Complaint at ¶ 1409 (“A balancing test to assist in determining the existence of a nuisance is whether the ‘gravity of the harm outweighs the social value of the activity alleged to cause the harm.’”).

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- Further, do I have an opinion about whether the net costs imposed by the sales and distribution of prescription opioid products in the Community were of sufficient magnitude to constitute a public nuisance to the Community?

8. I have been asked to limit my analysis to the time period of 2006 to the present or until the most recent period for which data are available to make reliable estimates. The years for which data are generally available, at this point in time, are through 2018. Should additional data become available during the course of this litigation, and if I am asked to do so by counsel, I can update my analysis to include more recent data.

9. Because these questions are framed in the context of the legal term “public nuisance,” I have been instructed by counsel to be guided by the following general definition of a public nuisance, as set forth in the Complaint:

“A public nuisance is an act or condition that unlawfully operates to hurt or inconvenience an indefinite number of persons. The distinction between a public nuisance and a private nuisance is that the former affects the general public, and the latter injures one person or a limited number of persons only.”¹¹

10. Counsel have also referred me to the following definition from the Complaint, drawn from the Restatement (Second) of Torts:

“A public nuisance is an unreasonable interference with a right common to the general public. Circumstances that may sustain a holding that an interference with a public right is unreasonable include the following:

- d. Whether the conduct involves a significant interference with the public health, the public safety, the public peace, the public comfort or the public convenience, or
- e. whether the conduct is proscribed by a statute, ordinance or administrative regulation, or

¹¹ Complaint, ¶ 1407 quoting *Sharon Steel Corp. v. City of Fairmont*, 334 S.E.2d 616, 620 (W. Va. 1985) (citing Restatement (Second) of Torts § 821B (1979)).

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- f. whether the conduct is of a continuing nature or has produced a permanent or long-lasting effect, and, as the actor knows or has reason to know, has a significant effect upon the public right.”¹²

11. It is my understanding that Plaintiffs will prove that the Defendants have unlawfully sold and distributed prescription opioids in the Cabell Huntington Community. My Report addresses the economic harms imposed by the sales and distribution of prescription opioids from 2006 through 2018.

C. Summary of Opinions

12. First, I am of the opinion that there is a framework within the area of applied microeconomics by which economists can determine the existence of, and measure the extent of, what is known under the law as a “public nuisance.” Within the field of economics there is a long tradition of analyzing the social consequences of private behaviors imposing harms on others, known as “negative externalities.” This economic framework provides a natural parallel to the legal notion of public nuisance.¹³

13. Second, I am of the opinion that the economic costs incurred in the Cabell Huntington Community by the sales and distribution of prescription opioids far exceed any benefits. I estimate, to a reasonable degree of certainty in the area of applied microeconomics, that the magnitude of the net economic costs imposed by the sales and distribution of prescription opioid products over the period 2006-2018 is approximately \$4.17 billion. The major components of these costs are listed in Table 1. Figure 1 depicts the relative shares of the harms making up the total. Most of the economic costs are attributed to death and disease, in accord with national studies on harms from the opioid epidemic. Other categories of cost, while large in absolute terms, as indicated by Table 1, are small relative to cost of death and disease. A point of emphasis throughout this Report is that standard economic methods underestimate the costs of harms in these “smaller” categories.

¹² Complaint, ¶ 1408 (footnote omitted).

¹³ K. Hylton frames the economics of a public nuisance as an externality. See K. Hylton, “The Economics of Public Nuisance Law and the New Enforcement Actions,” *Supreme Court Economic Review*, 18(1), February 2010, pp. 43-76. Other references are contained in Section II below.

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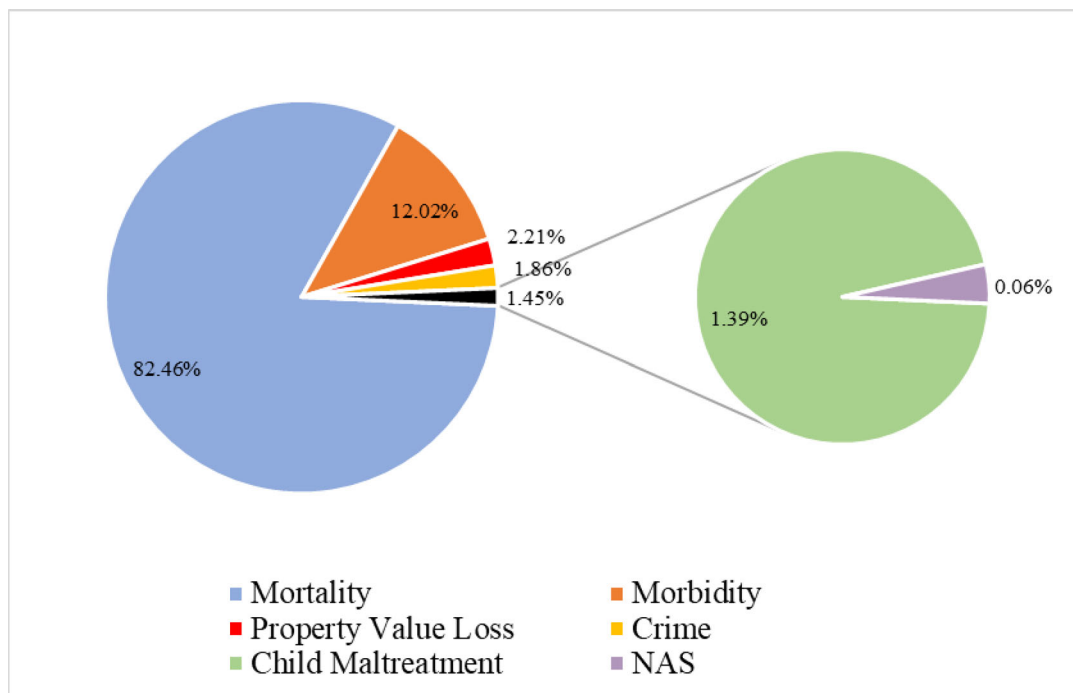
Table 1
Monetary Value of the Net Economic Costs Attributed to the
Sales and Distribution of Prescription Opioids
in the Cabell Huntington Community
2006-2018

Harms Due to Sales & Distribution of Prescription Opioids	Valuation (\$millions)
Excess deaths	\$3,437.8
Excess morbidity	\$501.3
Excess neonatal abstinence syndrome	\$2.6
Excess crimes	\$77.4
Excess property value loss	\$92.3
Excess child maltreatment	\$57.9
Total	\$4,169.2

Sources: Tables 3, 5, 7, 8, 9, and Section III.E of this Report.

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Figure 1
Percentage Value of Each Harm Attributed to the
Sales and Distribution of Prescription Opioids
in the Cabell Huntington Community
2006-2018



14. I have been instructed by counsel to report costs measured in dollars at the time they were incurred (as opposed to the equivalent costs in terms of dollars in 2020). A conversion to 2020 dollars can be done, if necessary, with standard methods. Doing so would substantially increase the dollar estimate of the net economic costs imposed.

15. Third, I conclude that sales and distribution of prescription opioid products imposed and continue to impose net economic costs of sufficient magnitude to constitute a public nuisance. As one indication, using the population of the Cabell Huntington Community in 2018 (96,619),¹⁴ the costs reported in Table 1 amounted, over this 13-year period, to approximately \$43 thousand per person in the Community.

¹⁴ This is the sum of the population of Cabell County, and the portion of the City of Huntington located in Wayne County. U.S. Census, Cabell County Population by Characteristics, 2010-2019 (<https://www.census.gov/data/tables/time-series/demo/popest/2010s-counties-detail.html>). The population of Huntington, Wayne County is 3,584.

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16. Fourth, my monetary estimates of the economic costs from the sales and distribution of prescription opioids underestimate the harm suffered by the Cabell Huntington Community. The inflow of prescription opioids injures Community residents in countless ways, not limited to a rash of fatal and non-fatal opioid overdoses, the taxing of the local health care system and social safety net, which are aimed at abating suffering from the numerous consequences of addiction, and an unprecedented number of babies born with neonatal abstinence syndrome. Standard economic approaches using available data fail to capture the full long-term devastation – damage to families and children, risk of crime, loss of employment, among other harms – that has befallen the Cabell Huntington Community and its residents due to the sales and distribution of prescription opioids. Because the long-term effects of the opioid epidemic are at present unknown, and because some harms are difficult to measure in economic terms using standard methods, some difficult-to-quantify harms from the analysis are excluded from the analysis. The estimates presented here are therefore conservative.

17. The next three sections of my Report correspond to the three parts of my assignment. In Section II, I discuss the economic analysis of a public nuisance. In Section III, I identify and quantify in economic terms the net costs in the Cabell Huntington Community due to the sales and distribution of prescription opioids. I cover costs in six groups of harms: mortality, morbidity from opioid-use disorder, neonatal abstinence syndrome, crime, loss of residential property value, and child maltreatment. Within the discussion of morbidity, I consider potentially offsetting economic benefits of prescription opioids in terms of workforce participation. Section IV summarizes the cost analysis and concludes that these costs are of sufficient magnitude to regard the sales and distribution of prescription opioids as constituting a public nuisance in the Cabell Huntington Community.

II. The Economic Analysis of Public Nuisances

18. I rely on the long tradition within the field of economics analyzing the social consequences of private behaviors imposing costs on others. A public nuisance occurs when an action (or set of actions) undertaken by a party (or group of parties) gives rise to overwhelming “negative externalities.” An externality “occurs whenever the actions of one party make another

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party worse or better off, yet the first party neither bears the costs nor receives the benefits of doing so.”¹⁵

19. A negative externality imposes costs on others. An example of a negative externality is pollution of a river.¹⁶ If a household or firm deposits waste in the river, other members of the community are harmed (*e.g.*, bear health risks, enjoy less recreational use of the river) but they are not compensated for the costs imposed on them. In economics, harms, such as health risks or loss of recreational opportunities, are regarded as a “cost” imposed on others and can be valued in dollar terms.

20. The legal concept of a public nuisance parallels the concept of a negative externality in economics, as has been recognized in legal scholarship: “Nuisance may also be viewed as a form of externality that interferes with the enjoyment or use of another’s property.”¹⁷

21. In a related approach, scholarship in law and economics sometimes refers to a public nuisance as a “public bad:” “The common law of public nuisance has evolved for dealing with public bads. When an agent imposes a cost, similar in amount and kind, on a group of individuals, then the harmed group can call upon a public defender to bring a public nuisance action against the agent.”¹⁸ “Public bads are ... said to emerge when a large number of parties are affected negatively and simultaneously, at the margin, by an action undertaken by an individual or group. The nature of the phenomenon is such that there is no low-cost way to insulate and partition the affected individuals in the group from the negative effect. What one group member receives, all receive.”¹⁹ I will use the economic concepts of public bad and

¹⁵ J. Gruber, *Public Finance and Public Policy*, 5th edition, 2016, p. 124.

¹⁶ An externality can be positive as well, that is, confer benefits on others. A neighborhood association might maintain a local park that is open to the public, benefiting those outside the immediate neighborhood as well as residents of the neighborhood.

¹⁷ T. Swanson and A. Kontoleon, “Nuisance (Section 2100),” in B. Bouckaert and G. de Geest (eds.), *Encyclopedia of Law and Economics*, 2000, pp. 380-402 at 382. See also, R. Cooter and T.S. Ulen, *Law and Economics*, 6th Edition, Berkeley Law Books, 2016, p. 168, and K. Hylton, *op. cit.*

¹⁸ K. Boudreaux and B. Yandle, “Public Bads and Public Nuisance-Common Law Remedies for Environmental Decline,” *Fordham Environmental Law Review*, 14(1), Article 2, 2002, pp. 55-88 at p. 65.

¹⁹ *Ibid.*, pp. 59-60.

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negative externality in determining whether the sales and distribution of prescription opioid products constitute a public nuisance to the Cabell Huntington Community in economic terms.²⁰

III. Economic Costs Imposed by the Sales and Distribution of Prescription Opioid Products in the Cabell Huntington Community

22. I quantify the net economic costs relating to deaths, morbidity, neonatal abstinence syndrome, crimes, property value loss, and child maltreatment in the Cabell Huntington Community over the period 2006 to 2018, unless otherwise noted. The methods I use to estimate costs of the components listed above are consistent with similar analyses conducted by numerous public and private agencies throughout the United States.²¹

23. It is difficult to overstate the impact of the opioid epidemic on the Cabell Huntington Community. West Virginia, and Cabell County in particular, is near the top of the nation on opioid overdose rates (fatal and non-fatal), number of babies born with neonatal abstinence syndrome (NAS), and the number of prescription opioids dispensed (both in absolute number and per capita). The opioid epidemic has contributed to outbreaks of other diseases, such as Hepatitis C and HIV, and led to burnout and trauma amongst police officers, fire fighters, emergency medical technicians, and other first responders. The unprecedented numbers of

²⁰ The relationship between public bad and negative externality is the same as between public good and positive externality. A public good involves positive externalities, but not all externalities are public goods. Pure public goods must be consumed in equal quantity by all and are completely non-rivalrous, *i.e.*, the consumption by one person does not affect the consumption by others. The classic papers are: P.A. Samuelson, “The Pure Theory of Public Expenditure,” *Review of Economics and Statistics*, 36(4), 1954, pp. 387-389, and P.A. Samuelson, “Diagrammatic Exposition of a Theory of Public Expenditure,” *Review of Economics and Statistics*, 37(4), 1955, pp. 350-356. Not all externalities possess these two characteristics in pure form, so I use the more general term, “externality.”

²¹ National studies include The Council of Economic Advisers (CEA), Executive Office of the President of the United States, “The Underestimated Cost of the Opioid Crisis,” November 2017 (<https://www.whitehouse.gov/sites/whitehouse.gov/files/images/The%20Underestimated%20Cost%20of%20the%20Opioid%20Crisis.pdf>); C.S. Florence, *et al.*, “The Economic Burden of Prescription Opioid Overdose, Abuse, and Dependence in the United States, 2013,” *Medical Care*, 54(10), 2016, pp. 901-906; C. Rhyan, “The Potential Societal Benefit of Eliminating Opioid Overdoses, Deaths, and Substance Use Disorders Exceeds \$95 Billion Per Year,” *Altarum*, November 16, 2017; and S. Davenport, A. Weaver and M. Caverly, “Economic Impact of Non-Medical Opioid Use in the United States: Annual Estimates and Projections for 2015 through 2019,” Society of Actuaries, 2019. The CEA studies costs of illicit and prescription opioids; Florence and coauthors work at the Center for Disease Control (CDC) and study costs of prescription opioid products; Rhyan studies costs of prescription and illicit products; and Davenport and his coauthors also study costs of prescription and illicit products.

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babies born with NAS will have long-lasting effects. The ravages of the opioid epidemic are far-reaching, affecting virtually all residents in the Community, much of it documented via media coverage on the different facets of the epidemic.²² The opioid epidemic has increased criminal activity, reduced housing values, and imposed a general loss of well-being in this Community.

24. Few communities have been hit as hard by the opioid epidemic as has the Cabell Huntington Community. A recent American Enterprise Institute (AEI) report analyzed the geographic variation of per capita costs due to the opioid crisis by state and county. The report identifies West Virginia as incurring the highest cost per capita among all states and Cabell County as ranking number 3 among over 3,000 counties nationwide.²³

25. The local response to the crisis has been equally forceful. Cabell Huntington Community leaders, policy makers, and public servants have launched a multipronged effort to study and combat the opioid epidemic. The Huntington Mayor's Office released comprehensive plans aimed at fighting the opioid epidemic focused on bolstering prevention efforts, providing greater access to a broader set of treatment services, and mitigating the inflow of opioids via law enforcement initiatives.²⁴ Huntington's Marshall University published the *Resiliency Plan*, a comprehensive guide for responding not only to the short-term issues associated with the opioid epidemic, but also preparing for its long-term economic and legal consequences.²⁵ The City of

²² Examples of national coverage of the Cabell Huntington Community's opioids epidemic include the Netflix Documentary "Heroin(e)" (<https://recoveryboysthefilm.com/about-heroine/>); a STAT profile: A. Joseph, "26 Overdoses in Just Hours: Inside a Community on the Front Lines of the Opioid Epidemic," *STAT*, August 22, 2016; and multimedia coverage by *The Atlantic*, entitled "A Heroin Hearse in the OD Capital of America" (<https://www.theatlantic.com/video/index/586753/heroin-hearse/>).

²³ See Tables 1 and 2 in A. Brill and S. Ganz, "The Geographic Variation in the Cost of the Opioid Crisis," American Enterprise Institute (AEI), Working Paper 2018-03, March 2018. They "estimate per-capita state-level and county-level non-mortality and total economic burdens of the opioid crisis in 2015 by distributing national estimates based on variation in local wages, health care costs, and criminal justice costs along with variation in opioid-related death and addiction rates, and average age-adjusted value of statistical lives lost."

²⁴ City of Huntington, Mayor's Office on Drug Control Policy, "2015 Strategic Plan," August 24, 2015 and then approximately two years later the "Two-Year Strategic Plan for Addressing the Opioid Crisis in the City of Huntington/Cabell and Wayne Counties, West Virginia" was released, May 2017.

²⁵ "Resiliency Plan Cabell County, WV," Division of Addiction Sciences, Marshall University Joan C. Edwards School of Medicine, January 2020 (https://jcesom.marshall.edu/media/58477/2020_cabell-county-resiliency-plan_final.pdf).

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Huntington compiled its successes (and failures) in *The City of Solutions*, providing guidance to other communities facing the opioid epidemic.²⁶

26. These reports depict the myriad ways prescription opioids imposed harms in the Community.²⁷ For example, the Mayor's "2015 Strategic Plan" notes, among other harms, that babies born with NAS cost significantly more than babies born without NAS: the later cost around \$10,000, whereas NAS births can be as much as \$55,000.²⁸ In another example, a review conducted by Marshall University found that state and local entities devote significant financial resources to opioid epidemic harm-reduction programs, including distribution of naloxone to local emergency units (*e.g.*, in 2016, the administration of 4,186 doses of the opioid antagonist).²⁹

27. The Cabell Huntington community has taken concrete actions to deal with harms. Treatment centers such as Lily's Place, Project Hope, and Healthy Connections, as well as the establishment of the Drug Court, focused on rehabilitation over punishment, are designed to aid those currently fighting drug addiction. These initiatives have required outsized efforts and resources.³⁰

²⁶ "The City of Solutions, Huntington WV: A Guide to What Works (and What Does Not) in Reducing the Impact of Substance Use on Local Communities," edited by J. Maiolo, Division of Addiction Sciences in the Department of Family and Community Health at the Marshall University Joan C. Edwards School of Medicine, September 2019 (philanthropywv.org/content/uploads/2019/11/COS-Guidebook-Finalized-as-of-9-26-19.pdf), hereafter, *The City of Solutions, Huntington, WV*.

²⁷ In 2015, Fire Chief Jan Rader compiled an annual estimate of medical costs of drug abuse in Cabell County. This estimate was introduced as a series of exhibits in Mr. Lemley's deposition (See Deposition of Scott Lemley, in this matter, July 3, 2020 (hereafter, *Lemley Deposition*), Exhibits 32-35). She identified average costs for the following categories related to drug abuse: overdose calls, overdose calls with hospitalization, drug use complications related to cellulitis, endocarditis, and osteomyelitis, NAS, hepatitis B and C without a transplant and liver transplant. Her total estimated cost was \$30.5 million. This compilation of costs illustrates some aspects of the costs resulting from the opioid epidemic.

²⁸ City of Huntington, "2015 Strategic Plan," *op. cit.*, p. 11.

²⁹ N. Bowden, *et al.*, "The Cost of the Opioid Epidemic in West Virginia," presented at the 54th Annual MBAA Conference, Chicago, IL, April 2018. While the initial expenses were paid by a federal grant, the growing need for opioid antagonists prompted the state of West Virginia to purchase 34,000 doses in 2018 at a cost of approximately \$1,000,000. See West Virginia Department of Health and Human Resources, "DHHR Begins Distributing Naloxone Statewide for First Responders," June 5, 2018 (<https://dhhr.wv.gov/News/2018/Pages/DHHR-Begins-Distributing-Naloxone-Statewide-for-First-Responders---.aspx>).

³⁰ Some examples of these costs are available in *The City of Solutions, Huntington WV*, pp. 63-66.

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28. Deposition testimony by county and city personnel confirm the profound impact of the opioid epidemic on the Cabell Huntington Community:

- Raymond Canafax, Deputy Chief of the Huntington Fire Department, testified: “But this – in my experience, this – this didn’t know any bounds, this epidemic. It was in all neighborhoods. It was in the best of neighborhoods and the worst of neighborhoods and the best – the best of homes to the worst of homes.”³¹
- Jan Rader, Fire Chief for the City of Huntington, testified: “There’s not one person in this area that I know that has not been touched or had collateral damage to them, themselves from the ... opioid epidemic. It is horrendous.”³²
- Sue Ann Painter, the executive director of the board of registered nurses, testified: “It’s been financially devastating to people with substance use disorder and their families and their communities. It has emotional impact on all the individuals involved, and people die of overdose.”³³
- Craig Preece, a long-time Huntington Police Department officer, testified: “...looking back over those 22 years, that opioids and everything that came after prescription meds, that’s what was the most damaging ... to the City as far as people and maybe their quality of life.”³⁴
- Officer Preece adds, describing to the impact opioids have had on the City of Huntington that: “It’s resulted in a lot of deaths. It’s resulted in a lot of criminal charges. It’s resulted in people that remain addicted that continue to seek opioid type drugs to this day. There’s been robberies, thefts and violence associated with the drug.”³⁵

29. While I quantify some of the harms identified above, my valuations omit aspects of the harms that are difficult to measure with standard economic methods or for which data are unavailable as a basis for reliable estimates. For example, babies born with NAS incur higher health care expenditures at birth, which I am able to quantify. However, there is also evidence that these babies are more likely to suffer a range of health consequences later in life and to have poor economic outcomes, but due to data limitations, I am unable to fully quantify these aspects of the harms. Similarly, the stress from increasing numbers of overdoses has very real psychological consequences for first responders, which ultimately affects recruitment and

³¹ Deposition of Raymond Carafax, in this matter, June 16, 2020 (hereafter, Carafax Deposition), p. 120.

³² Deposition of Jan Rader, in this matter, June 17, 2020 (hereafter, Rader Deposition), pp. 78-9.

³³ Deposition of Sue Ann Painter, in this matter, June 26, 2020, p. 162.

³⁴ Deposition of Craig Preece, in this matter, July 14th, 2020 (hereafter, Preece Deposition), p. 298.

³⁵ Preece Deposition, pp. 298-99.

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retention of these critical public servants. Here again, due to data limitations, I am unable to fully quantify these harms resulting from the sales and distribution of prescription opioids. Moreover, while the opioid crisis harms the Cabell Huntington Community, due to data limitations, most of my harm qualifications are limited to Cabell County.³⁶

30. The sales and distribution of massive volumes of prescription opioids into the Community has had devastating downstream consequences. One of the central facts of the opioid epidemic is that the majority of individuals who misuse opioids began with prescription opioids before turning to heroin, or other opioids.³⁷ For example, Cerda, *et al.* (2015) find that among children and adolescents, prior non-medical use of prescription opioids was strongly predictive of later use of heroin.³⁸ Non-medical use of prescription opioids is defined as “...both using prescription opioids more often or longer than prescribed, or use of prescription opioids without a prescription.”³⁹

31. Dr. Lembke in her report, explains that the “gateway effect” of prescription opioids includes the transition from medical use of prescription opioids to non-medical use.⁴⁰ Among other studies, Dr. Lembke cites McCabe, *et al.*, in the journal *Pediatrics*, in which the “gateway

³⁶ Except for crime, where I use data for the entire city from the City of Huntington Police Department, my harm valuations exclude the portion of Huntington located in Wayne county.

³⁷ There is substantial evidence that the gateway to illicit opioids is prescription opioids. For examples, see C.M. Jones, “Heroin Use and Heroin Use Risk Behaviors Among Nonmedical Users Of Prescription Opioid Pain Relievers – United States, 2002-2004 And 2008-2010,” *Drug and Alcohol Dependence*, 132, 2013, pp. 95-100 (found that between the periods of 2002-2004 and 2008-2010, there was an increase of heroin use among people who had used opioid pain relievers non-medically in the past year); P.K. Muhuri, J.C. Gfroerer, and M.C. Davies, “Associations of Nonmedical Pain Reliever Use and Initiation Of Heroin Use in The United States,” CBHSQ Data Review, August 2013 (showed that the incidence of heroin use (from 2002-2011) was 19 times higher among those reporting prior non-medical pain reliever use, compared to those who had not used pain relievers non-medically); T.J. Cicero, M.S. Ellis, H.L. Surratt, and S.P. Kurtz, “The Changing Face of Heroin Use in the United States: A Retrospective Analysis of the Past 50 Years,” *JAMA Psychiatry*, 71(7), 2014, pp. 821-826 (found, among other things, that 75% of patients seeking treatment for heroin abuse from 2004-2014 had been introduced to opioids through prescription drugs); and G. Banerjee, *et al.*, “Non-medical Use of Prescription Opioids is Associated with Heroin Initiation Among US veterans: a Prospective Cohort Study,” *Addiction*, 111, 2016, pp. 2021-2031 (estimated the influence of non-medical use of prescription opioids on heroin initiation in U.S. veterans receiving medical care and found that non-medical use of prescription opioids was associated positively and independently with heroin initiation).

³⁸ M. Cerda, *et al.*, “Nonmedical Prescription Opioid Use in Childhood and Early Adolescence Predicts Transitions to Heroin Use in Young Adulthood: A National Study,” *Journal of Pediatrics*, 167(3), September 2015, pp. 605-12. See also, Cicero, *et al.*, *op. cit.*

³⁹ Expert Report of Professor Katherine Keyes, in this matter, August 3, 2020 (hereafter Keyes Report), p. 7.

⁴⁰ Expert Report, Anna Lembke, M.D., in this matter, August 3, 2020 (hereafter Lembke Report), Paragraph C.8.

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effect” refers to the transition from medical to non-medical use of prescription opioids, and subsequent use of illicit opioids.⁴¹ The massive inflow of prescription opioids into the Cabell Huntington Community permitted diversion to non-medical use of prescription opioids.⁴² Numerous studies find that most non-medical users obtain opioids at some point from a medical provider and/or from family/friends who obtained them from a medical provider.⁴³ Moreover, Dr. Smith, an epidemiologist and professor at West Virginia University, Department of Epidemiology, notes that the overdose data he analyzes “support the recognized transition from prescription to illicit opioids use, which has been documented in numerous peer-reviewed studies of the US population in general, and...the same thing occurred throughout West Virginia, including Cabell County.”⁴⁴

32. Deposition testimony confirms that prescription opioids are a gateway to other opioids in the Community:

- Jan Rader, Fire Chief, testified: “When people who were addicted couldn't find the pills that they had been on for years, they turned to heroin because it was cheaper and easier to obtain. They were using a needle to inject it into their body, spreading bacteria. You had all kinds of medical complications associated with it. But again, probably 80 percent of them - especially in my experience - started with a legal prescription.”⁴⁵
- Paul Hunter, a Huntington Police Sergeant and part of the Drug and Violent Crimes Task Force as well as head of the City Law Enforcement Narcotics Unit, testified: “The heroin appeared to come into existence, or the use of it, shortly after prescription pills were a problem. And just from my investigation, talking to cheaper version and it was easier to get at times. They started getting heroin.”⁴⁶

⁴¹ S.E. McCabe, *et al.*, “Trends in Medical and Nonmedical use of Prescription Opioids Among US Adolescents: 1976–2015,” *Pediatrics*, 139(4), 2017, pp. 1-9. The Lembke Report discussion of the McCabe, *et al.* study is on paragraph C.8.d, p. 132

⁴² Keyes Report, Opinion 5, p. 5.

⁴³ R.N. Lipari and A. Hughes, “How People Obtain the Prescription Pain Relievers they Misuse,” The CBHSQ Report: January 12, 2017, Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration, Rockville, MD; J.A. Inciardi, H.L. Surratt, T.J. Cicero, S.P. Kurtz, S.S. Martin, and M.W. Parrino, “The ‘Black Box’ of Prescription Drug Diversion,” *Journal of Addictive Diseases*, 28(4), 2009, pp. 332-347.

⁴⁴ Expert Report, Gordon Smith, M.D., in this matter, August 3, 2020 (hereafter Smith Report), p. 10.

⁴⁵ Rader Deposition, pp. 85-86.

⁴⁶ Deposition of Paul Hunter, in this matter, July 1, 2020, p. 246.

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33. From an economic standpoint, the costs due to the sales and distribution of prescription opioids include costs for which prescription opioids are the proximate cause (*e.g.*, a death from overdose of prescription opioids) and those for which prescription opioids were the ultimate but not necessarily the proximate cause (*e.g.*, a death from fentanyl for someone using fentanyl because of their start on prescription opioids). Dr. Lembke, a physician,⁴⁷ and Professor Keyes, an epidemiologist,⁴⁸ elaborate on the role of prescription opioids as a gateway drug.

A. MortalityOverview

34. The economic cost of mortality attributed to the sales and distribution of prescription opioid products is the number of deaths due to these sales and distributions in the Cabell Huntington Community multiplied by the value of each life lost.

35. The valuation undertaken in this section is conservative in that it values a life only in terms of the “willingness to pay” of the person at risk of death. Beyond the self-evident harm of the loss of life to the victim, an opioid-overdose death impacts families and the Cabell Huntington Community in ways difficult to value with economic methods. For example, in 2018, about 55% of West Virginia’s opioid fatalities were adults between 25-44,⁴⁹ many of whom were parents caring for small children.⁵⁰ Harms to these children go unmeasured in my valuation of a death. A death is a loss of companionship and friendship to spouses or romantic partners, friends, and the community. These harms go unmeasured in my valuation. Moreover, Cabell Huntington Community first responders face increased job stress due to ongoing dealings with large numbers of fatal opioid overdose fatalities. This increased stress on first responders

⁴⁷ Lembke Report, Paragraph C.8.g, p.134.

⁴⁸ Keyes Report, p. 44 contains a discussion of the causal link between prescription opioids and subsequent heroin use.

⁴⁹ Kaiser Family Foundation analysis of Centers for Disease Control and Prevention (CDC), National Center for Health Statistics. Multiple Cause of Death 1999-2018 on CDC WONDER Online Database, released 2020. Data are from the Multiple Cause of Death Files, 1999-2018, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. Accessed on February 13, 2020. The calculation is the ratio of the deaths for people aged 25-44 (387) and the total number of deaths (702). See <http://www.kff.org/other/state-indicator/opioid-overdose-deaths-by-age-group>.

⁵⁰ C. Levine, *et al.*, “The Statistics Can’t Capture the Opioid Epidemic’s Impact on Children.” *STAT*, December 30, 2017 (www.statnews.com/2018/01/02/opioid-epidemic-impact-children/).

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results in public sector costs for training and counseling for firefighters, police officers and EMS personnel,⁵¹ results in what has been called “compassion fatigue”⁵² that takes a personal toll,⁵³ and results in difficulties retaining personnel.⁵⁴ Deputy Chief Canafax commented on compassion fatigue: “Our firefighters were getting exhausted, and were – both mentally and physically, and this was affecting their mental wellbeing.”⁵⁵ These human and economic tolls on first responders are also not quantified in my valuation of a death attributed to prescription opioids.

36. While the opioid epidemic has taken an enormous toll in the United States, the Cabell Huntington Community has been especially hard hit. Figure 2 depicts the outsized harm suffered by Cabell County in the form of prescription opioid-related deaths. The data come from Professor Keyes’ report, and compare the rate of deaths proximately caused by prescription opioids in Cabell County, West Virginia and the United States from 1999-2018.⁵⁶ West Virginia was hit harder than other states, and within West Virginia, Cabell was hit harder than other counties.

⁵¹ The City of Solutions, Huntington WV, p. 54.; “Resiliency Plan for Cabell County,” *Division of Addiction Sciences*, Marshall University Joan C. Edwards School of Medicine, January 2020 (https://jcesom.marshall.edu/media/58477/2020_cabell-county-resiliency-plan_final.pdf/).

⁵² See E.L. Winstanley, “The Bell Tolls for Thee & Thine: Compassion Fatigue & the Overdose Epidemic,” *International Journal of Drug Policy*, June 1, 2020.

⁵³ The City of Solutions, Huntington WV, p. 42.

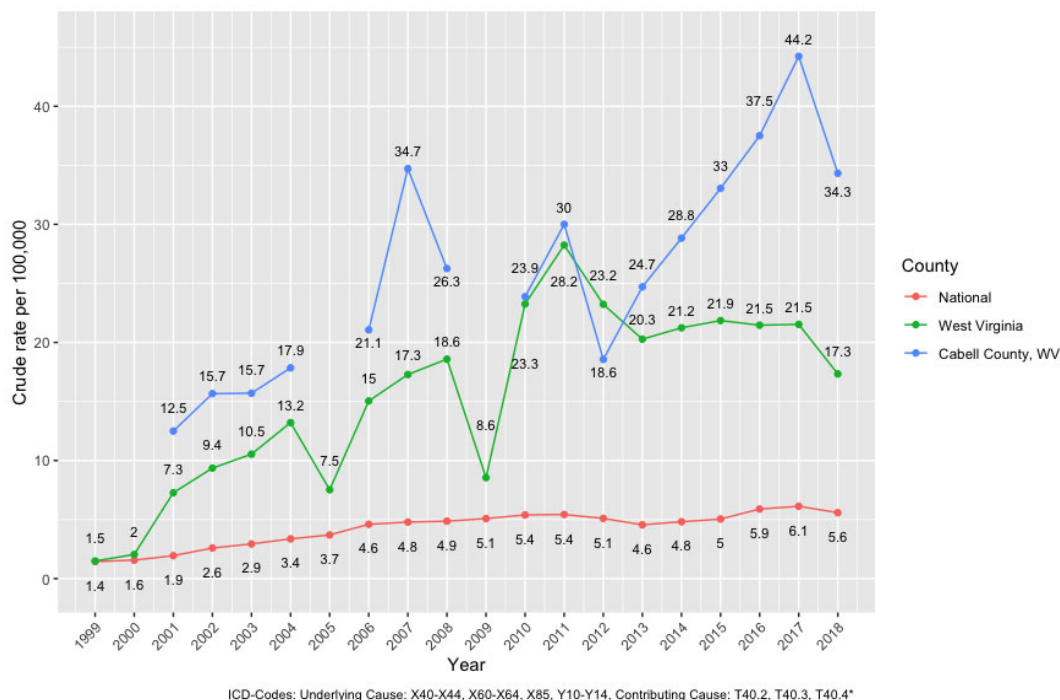
⁵⁴ See interview with Fire Chief Jan Rader, Medium.com/@BloombergCities, “How One Fire Chief is Fighting ‘Compassion Fatigue’ as Overdoses Mount,” May 10, 2018 (<https://medium.com/@BloombergCities/how-one-fire-chief-is-fighting-compassion-fatigue-as-overdoses-mount-f4c193323922>).

⁵⁵ Canafax Deposition, p. 118.

⁵⁶ Keyes Report, Figure 8. See page 31 of her report for a description of the methodology and sources for these figures.

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Figure 2
Prescription Opioid Death Rates
National, West Virginia and Cabell County Rates
Replication of Keyes Report, Figure 8

Count of Deaths

37. Professor Keyes identifies the number of deaths due to the sales and distribution of prescription opioids for Cabell County residents in each year from 2006 to 2018.⁵⁷ My Table 2 takes the numbers from Figure 16 from the Keyes Report. Professor Keyes explains her estimates of the number of deaths due directly and indirectly to prescription opioids:

“Opioid overdose deaths for which a prescription opioid was listed on the death certificate as a contributing cause are deemed directly due to prescription opioids. Among other deaths, I estimate that a minimum of 53.4% of deaths are indirectly due to prescription opioids, given the NSDUH data estimates of the proportion of non-prescription opioid use disorder for which prescription opioids were a preceding substance use. Therefore, Figure 16 provides the total number of opioid overdose deaths

⁵⁷ Keyes Report, Figure 16.

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in Cabell County for each year from 2006 through 2018, with the number directly attributable and minimum number indirectly attributable to prescription opioids.”⁵⁸

38. I rely on Professor Keyes’ estimates of deaths due to prescription opioids for my mortality counts.

39. Deaths in Cabell County due to all opioids went up by a factor of four or more between the early and more recent years in the data. Over the entire time period, over half of deaths, approximately 85.4% (556/651) were due directly to prescription opioids. 52 deaths were from a non-prescription opioid that were attributable to the user starting on prescription opioids. Deaths in this category in Cabell County spiked in the 2015-2018 period.

Table 2
Deaths Due to Prescription Opioids in Cabell County
2006-2018

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
All deaths due to opioids	21	37	25	5	25	36	22	42	45	69	87	132	105	651
Deaths directly due to prescription opioids	20	33	25	5	23	29	18	26	32	48	69	124	104	556
Deaths due to non-prescription opioids	1	4	0	0	2	7	4	16	13	21	18	8	1	95
Deaths due to non-prescription opioids due to prescription opioids	1	2	0	0	1	4	2	9	7	11	10	4	1	52
Total deaths due to prescription opioids	21	35	25	5	24	33	20	35	39	59	79	128	105	608

Sources: Keyes Report, Figure 16.

40. In total, over the period 2006-2018, 608 Cabell County residents died due to the sales and distribution of prescription opioids. The economic cost of these deaths constitutes the largest component of the harms assessed in this Report, consistent with the findings of other studies of the costs of the opioid epidemic.⁵⁹

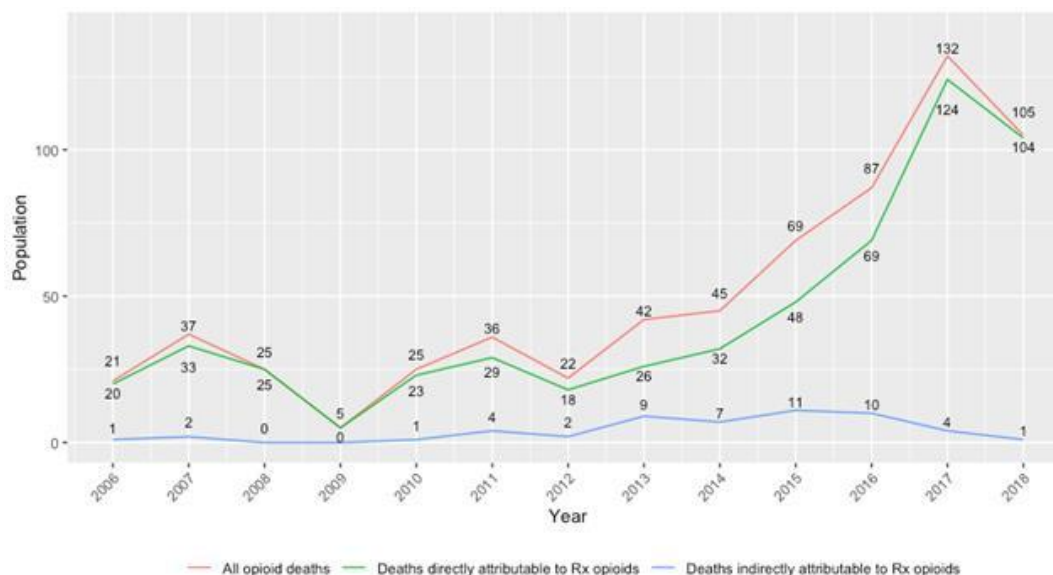
⁵⁸ Keyes Report, p. 48.

⁵⁹ For example, the CEA’s “The Underestimated Cost of the Opioid Crisis,” *op. cit.*, finds that costs associated with mortality, using a similar approach to value attribution that I use in this Report, based on the Value of a Statistical Life (VSL) account for about 84% of the total of mortality and morbidity costs. The CEA report refers to these as “fatality” and “non-fatality” costs. See CEA (2017), Table 2. The 84% is based on the “middle” estimate of the VSL contained in the table.

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41. Figure 3 graphs the data from Table 2, displaying the massive growth in deaths due to prescription opioids over the period 2006 to 2018. The figure conveys visually that the vast majority of the deaths were directly due to prescription opioids.

Figure 3
Deaths Due to Prescription Opioids in Cabell County
2006-2018
Replication of Keyes Report, Figure 16



Valuation of Deaths

42. An accounting of the economic cost of a death can be made with the economic concept of the value of a “statistical life,” used by researchers and government agencies to assign a dollar value to the economic cost of a death.⁶⁰ I rely on guidance from the Assistant Secretary for Planning and Evaluation (ASPE) of the U.S. Department of Health and Human Services (HHS)

⁶⁰ The VSL is figured as the ratio of the maximum willingness to pay for a given reduction in the probability risk of death within a specified time period. This yields a monetary amount per statistical life saved. For example, if I were willing to pay \$10,000 to avoid a 1/100 risk of death, the VSL would be measured as $\$10,000 \times 100 = \10m . See L. Robinson and J. Hammitt, “Valuing Reductions in Fatal Illness Risks: Implications of Recent Research,” *Health Economics*, 25, 2016, pp 1039-1052. The methodology for measuring the VSL is discussed in more detail in Appendix C.

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and use \$9.3 million as the national value of a statistical life (VSL) in 2014.⁶¹ The national value of \$9.3 million in 2014 can be adjusted using standard methods to different years and different geographic areas; I refer to this as the adjusted VSL. Price levels are adjusted based on the annual values of the Consumer Price Index (CPI). My VSL estimate is also adjusted for the differences in income between the national estimate and Cabell County for each year.

43. Table 3 takes the total number of deaths attributed to the sales and distribution of prescription opioids in Cabell County from 2006-2018 from Table 2, and multiplies each death by the adjusted VSL for each year for Cabell County.⁶² Over this 13-year time period, the measure of the economic value of lost lives is over \$3.43 billion for Cabell County.⁶³

Table 3
Valuation of Mortality Due to Prescription Opioids in Cabell County
2006-2018

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Total deaths attributed to prescription opioids	21	35	25	5	24	33	20	35	39	59	79	128	105	608
VSL (\$millions)	\$4.6	\$3.9	\$4.2	\$4.8	\$5.2	\$5.7	\$5.4	\$6.3	\$5.1	\$6.3	\$6.4	\$5.2	\$6.5	
Valuation (\$millions)	\$96.1	\$137.5	\$104.6	\$24.0	\$125.5	\$186.6	\$107.2	\$219.1	\$200.5	\$373.3	\$505.9	\$671.2	\$686.2	\$3,437.8

Sources: Appendix C, Section I.

B. Morbidity

Overview

44. The sales and distribution of prescription opioids contribute to opioid-related morbidity. Morbidity simply means to have a disease or be in ill health. The economic valuation in this

⁶¹ Office of the Assistant Secretary for Planning and Evaluation (ASPE), U.S. Department of Health and Human Services (HHS), “Guidelines for Regulatory Impact Analysis,” 2016 (https://aspe.hhs.gov/system/files/pdf/242926/HHS_RIAGuidance.pdf) (hereafter, “HHS 2016 Guidelines”).

⁶² See Appendix C for a description of the adjustments made.

⁶³ The HHS Guidelines report lower and upper bounds for national VSL of \$4.4 million and \$14.2 million for 2014. Using these values instead of the average used above results in an economic value of lost lives of \$1.6 billion and \$5.3 billion, respectively. Note that the number of intentional deaths data in Cabell County are too few to determine a reliable estimate. Data are suppressed due to small numbers in several years during this period. I therefore make no adjustments for intentional deaths in this report. See Keyes Report, p. 33.

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section is the number of cases of Opioid Use Disorder (OUD) due to prescription opioids multiplied by the excess health care costs associated with the treatment of OUD and *sequelae*.

45. OUD is a substance use disorder characterized by impaired control over opioids use, including but not limited to the need to use more opioids to achieve desired effects, withdrawal symptoms upon cessation of use, and adverse social, interpersonal, occupational, and physical consequences of opioid use.⁶⁴ The diagnosis of OUD is used by health care providers and criteria are included in major disease classification systems such as the Diagnostic and Statistical Manual of Mental Health Disorders (DSM).⁶⁵ According to the federal Centers for Disease Control and Prevention (CDC), based on household surveys, there were at least 2.1 million Americans with OUD as of 2017.⁶⁶

46. As is the case with mortality, OUD morbidity has hit the Cabell Huntington Community harder than other parts of West Virginia, and by an even larger margin, other parts of the country as a whole. Figure 5 shows the prevalence of OUD in Cabell County, West Virginia, and the United States from 2006-2018.⁶⁷

⁶⁴ See Keyes Report, Section III, pp. 7-8 for a discussion on the distinction between OUD, opioid abuse, and opioid dependence, which are defined *disorders*. Professor Keyes also discusses related *symptoms*, such as physical opioid dependence, opioid tolerance, and withdrawal which are included in the definition of OUD.

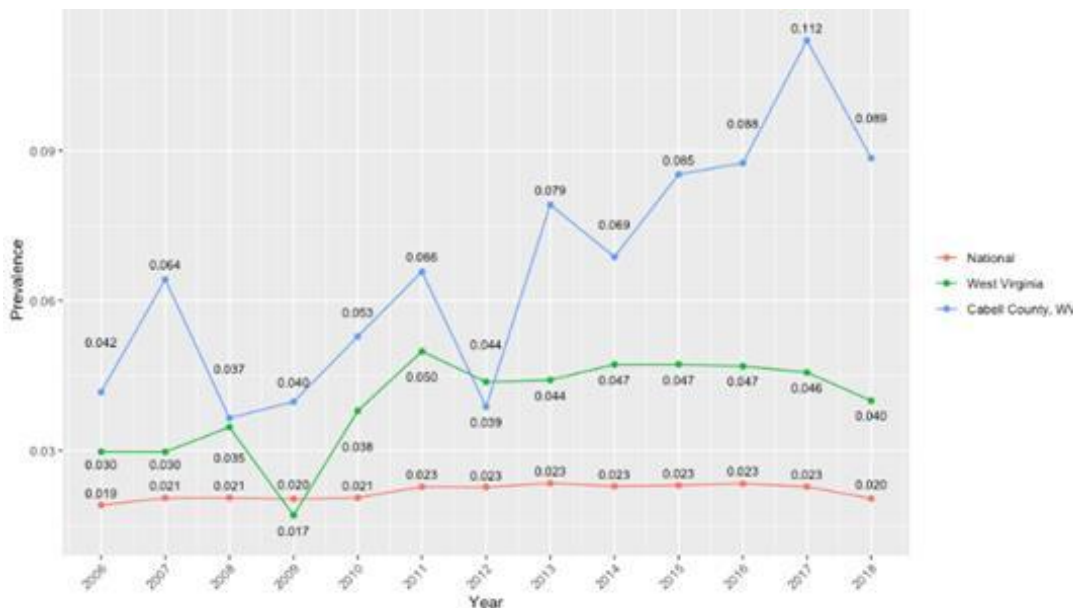
⁶⁵ *Ibid.*

⁶⁶ CDC and U.S. Department of Health and Human Services, “Annual Surveillance Report of Drug-Related Risks and Outcomes – United States, Surveillance Special Report,” 2019 at p. 17.

⁶⁷ Keyes Report, Figure 13.

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Figure 5
OD Prevalence
National, West Virginia and Cabell County
Replication of Keyes Report, Figure 13



Count of Morbidity

47. Table 4 takes numbers from Keyes Report Figure 14 for the estimated number of residents of Cabell County with OUD and those with OUD attributable to prescription opioids over the years 2006-2018.⁶⁸ The first row of the Table reports the number of all cases of OUD. The second row contains the number of cases of OUD Professor Keyes attributes directly due to prescription opioids.⁶⁹ Among the cases of OUD not directly due to prescription opioids (third row of Table 4), Professor Keyes attributes a share of these indirectly to prescription opioids. Professor Keyes' estimates of the number of cases of OUD due to non-prescription opioids that are ultimately due to prescription opioids are in the fourth row of the Table. Specifically, Professor Keyes opines that "...a minimum of 53.4% of opioid use disorder cases and deaths in the Cabell Huntington Community are indirectly attributable to prescription opioids, averaged

⁶⁸ Keyes Report, Figure 14 (p. 42).

⁶⁹ Keyes Report, Figure 14 (p. 42).

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across years from 2006 to 2014.”⁷⁰ The total number of people with OUD in each year in Cabell County attributable to prescription opioids (fifth row) is the sum of those with OUD due to prescription opioids, and those with OUD from other opioids that is attributable to opioid prescriptions.⁷¹ In terms of a share, as shown in the sixth row, Professor Keyes’ estimates imply that from 2006 – 2018, over 90% of OUD cases in Cabell County are ultimately due to prescription opioids.

Table 4
Morbidity Due to Prescription Opioids in Cabell County
2006-2018

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
All OUD cases	3,959	6,105	3,475	3,819	5,089	6,359	3,763	7,692	6,677	8,257	8,403	10,643	8,252	82,493
OUD cases directly due to prescription opioids	3,745	5,776	3,385	3,721	4,867	6,083	3,264	6,674	5,267	6,076	5,711	7,156	5,800	67,525
OUD cases due to non-prescription opioids	214	329	90	98	222	276	499	1,018	1,410	2,181	2,692	3,487	2,452	14,968
OUD cases due to non-prescription opioids due to prescription opioids	114	176	48	52	118	147	266	544	753	1,164	1,437	1,862	1,309	7,990
Total OUD cases due to prescription opioids	3,859	5,952	3,433	3,773	4,985	6,230	3,530	7,218	6,020	7,240	7,148	9,018	7,109	75,515
Share of OUD cases due to prescription opioids	97.5%	97.5%	98.8%	98.8%	98.0%	98.0%	93.8%	93.8%	90.2%	87.7%	85.1%	84.7%	86.1%	91.5%

Sources: Keyes Report, Figure 14.

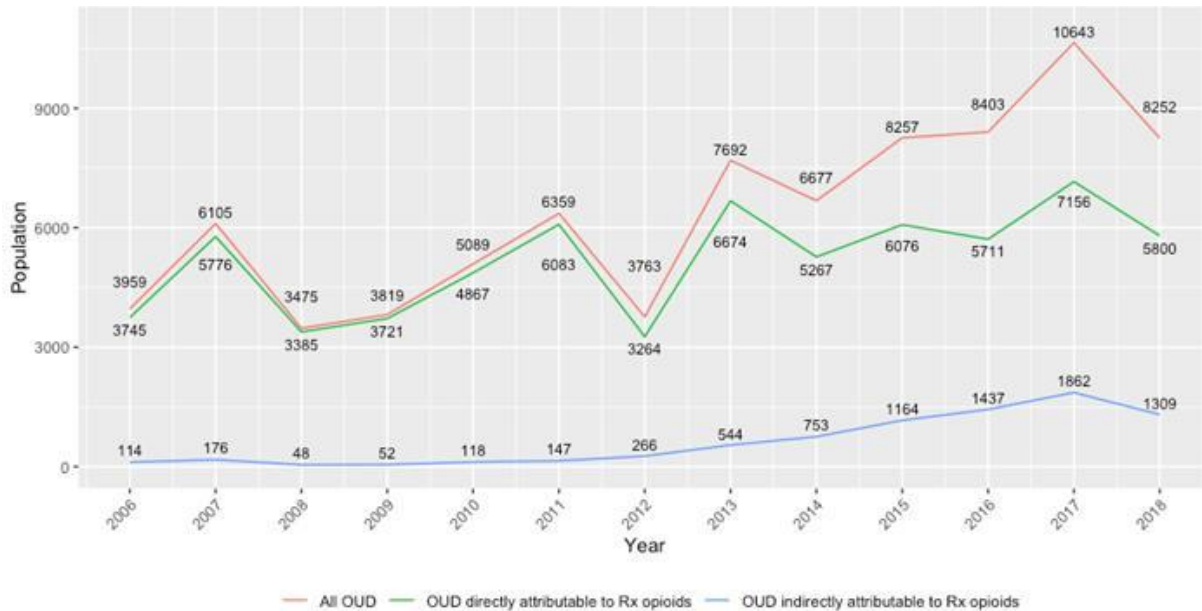
48. Figure 6 graphs the data from Table 4, depicting the rise in the number of OUD cases. In the later years, cases of OUD due to non-prescription opioids attributable to prescription opioids make up a larger share of the total.

⁷⁰ Keyes Report, p. 48.

⁷¹ See Keyes Report, pp. 47-48, for a description of the methodology used to compile these estimates.

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Figure 6
Morbidity Due to Prescription Opioids in Cabell County
2006-2018
Replication of Keyes Report, Figure 14



Valuation of Morbidity

49. I conservatively value the economic effects of morbidity attributed to opioid prescriptions in terms of higher health care costs. The opioid epidemic has increased health care utilization. Individuals with OUD consume more health care both to treat their OUD (e.g., addiction services, MOUD, etc.) and to treat comorbidities, such as hepatitis C and HIV, which occur in greater frequencies among patients with OUD.⁷² Researchers examining the additional health care costs resulting from OUD have measured the magnitude of excess health care costs due to OUD applying a “cost-of-illness” methodology. The basic approach compares the health care costs of individuals with OUD to a comparison group of individuals with similar insurance, sociodemographic, and other characteristics. The goal is to compare the costs for all health care,

⁷² J.S. Morrison and L. Dattilo, “America’s Dangerous Syndemic: Opioid Addiction, HIV, and Hepatitis C,” *Center for Strategic & International Studies*, December 2017; P.J. Peters, et al., “HIV Infection Linked to Injection Use of Oxymorphone in Indiana, 2014-2015,” *New England Journal of Medicine*, 375(3), 2016, pp. 229-239; E. Nilsen, “America’s Opioid Crisis has Become an ‘Epidemic of Epidemics,’” *Vox*, March 6, 2018 (<https://www.vox.com/2018/3/6/16453530america-opioid-crisis-epidemic-bacterial-endocarditis-hepatitis-c>).

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not just OUD treatment, resulting from OUD, after controlling for other health factors. For example, suppose there are two 40-year-old male patients with private insurance. One patient suffers from OUD and the second does not. These analyses compare the health care spending over 12 months for these two patients, starting at the time of the first OUD diagnosis for the individual with OUD. The difference in their health care spending is the excess health care cost attributable to OUD.

50. The cost-of-illness methodology is equipped to capture OUD-related elevated health care costs for diseases other than OUD. Studies of the elevated risk of particular diseases support the finding that health care costs for those with OUD are likely to be higher for a host of reasons. Individuals with OUD that transition to intravenous opioid administration are at elevated risk for transmission of Hepatitis B, C and HIV due to needle sharing and misuse.⁷³ Opioid users are also at elevated risk of sexually transmitted diseases due to risky behavior.⁷⁴ Individuals with OUD are also less likely to take up and adhere to effective contraception and contraceptive care.⁷⁵

51. Data from Cabell County confirm that local experience accords with national research. An HIV cluster was recently identified in Cabell County with 71 cases reported, which represented “a sharp uptick from the baseline average of eight cases annually over the past five years” and represented more cases than in all of West Virginia since 2008.⁷⁶ According to the DHHR (Department of Health and Human Services, WV), “The increase reflects a shift in how HIV is being more frequently transmitted, not so much from sexual contact but more so from being passed among intravenous drug users.”⁷⁷

⁷³ K.M. Rich, *et al.*, “Integrated Models of Care for Individuals with Opioid Use Disorder: How do we Prevent HIV and HCV?” *Current HIV/AIDS Reports*, 15(3), 2018, pp. 266-275; M.R. Golden, *et al.*, “Outbreak of Human Immunodeficiency Virus Infection Among Heterosexual Persons Who are Living Homeless and Inject Drugs – Seattle, Washington, 2018,” *Morbidity and Mortality Weekly Report*, 68(15), 2019, p. 344.

⁷⁴ D.C. Perlman, D.C. Des Jarlais, and J. Feelemyer, “Can HIV and Hepatitis C Virus Infection be Eliminated Among Persons Who Inject Drugs?” *Journal of Addictive Diseases*, 2015, 34(2-3), pp. 198-205.

⁷⁵ R.C. Bowers, *et al.*, “Failure of Effective Contraception in Opioid Addicted Mothers: A Disparity in Planned and Actual Usage,” *Marshall Journal of Medicine*. 2019, 5(1), pp. 41-49.

⁷⁶ See, B. Nash, “DHHR Says Cabell HIV Cluster is Growing,” *Charleston Gazette-Mail*, August 12, 2019 (https://www.wvgazettemail.com/news/health/dhhr-says-cabell-hiv-cluster-is-growing/article_ba37b709-32ec-5b16-8b8c-32867037b9b1.html).

⁷⁷ *Ibid.*

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52. OUD elevated prevalence of infective endocarditis (IE) in the Huntington region. As a 2019 paper reporting data from the Charleston Area Medical Center (a one hour drive from Huntington on I-64) puts it, “One of the potentially lethal and costly complications associated with IV drug use is infective endocarditis (IE).”⁷⁸ The number of cases of IV-associated IE at the hospital doubled between 2008 and 2015. Third-party payers cover only part of the average charges of \$37,500 for a case.⁷⁹ Other regional hospitals have been similarly affected. A report from the University of Cincinnati Medical Center (a 2 hour-40 minute drive from Huntington on Kentucky Route 9) also reports a doubling of IE cases over the period 1999-2009.⁸⁰ Using data on payments (rather than charges), the authors found that for the largest payer group, Medicare and Medicaid, the average hospital payment was \$95,799. They point out that this figure understates cost because physician fees are not included. Furthermore, IE patients are generally transferred to a skilled nursing facility to complete a typical minimum 6-week course of IV antibiotics.⁸¹ Higher rates of increase in IE have been found in other regions of the country.⁸² Dr. Ellen Thompson, a cardiologist at Marshall Health, reports growth of IE cases in Huntington due to IV drug use that match the upward, national trends.⁸³ Specifically, she reports that IE cases in Cabell Huntington Hospital have increased from 11 in 2010, to 86 in 2018.⁸⁴

53. Table C.II.1 in Appendix C lists studies applying the cost-of-illness methodology to OUD and summarizes their results in terms of estimated excess costs. In one well-known study, Florence, *et al.* (2016) estimate the excess health care costs attributable to OUD for patients with Medicare, Medicaid and private insurance in 2013. They find that health care costs were

⁷⁸ M.C. Bates, *et al.*, “Increasing Incidence of IV Drug Use Associated Endocarditis in Southern West Virginia and Potential Economic Impact,” *Clinical Cardiology*, 42, 2019, pp. 432-437 at 432.

⁷⁹ Calculated from Table 3 of Bates *et al.*, *ibid.* Bates, *et al.* figure that third-party payers covered only 22% of charges overall. Hospital costs are less than charges, but not by that magnitude. In West Virginia, from 2006-2018, the average charge to cost ratio was 40%.

⁸⁰ S. Keeshin and J. Feinberg, “Endocarditis as a Marker for New Epidemics of Injection Drug Use,” *American Journal of the Medical Sciences*, 352(6), December 2016, pp. 609–614.

⁸¹ *Ibid.*

⁸² A. Fleischauer, *et al.*, “Hospitalizations for Endocarditis and Associated Health Care Costs Among Persons with Diagnosed Drug Dependence – North Carolina, 2010–2015,” *Morbidity and Mortality Weekly Report*, 66 (22), June 9, 2017, pp. 569-573.

⁸³ Expert Report of Ellen Thompson, M.D., August 3, 2020, p. 2.

⁸⁴ *Ibid.*

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\$15,500 higher for commercially insured patients, \$17,052 higher for Medicare patients, and \$13,743 higher for Medicaid patients.⁸⁵ A recent study by Leslie, *et al.* (2019) estimates the excess health care costs for Medicaid patients for each year from 1999 through 2013.⁸⁶ Another recent study sponsored by the Society of Actuaries estimates excess costs for Medicaid as well as other major payers over the period 2015-2018.⁸⁷ I primarily rely on these later two studies to quantify excess health care costs due to OUD.

54. Table 5 reports the number and valuation of excess health care costs attributed to sales and distribution of prescription opioid products in Cabell County from 2006-2018. Total morbidity costs are the product of the share of OUD cases in each of the two major payer categories (Medicare/Commercial in the second row and Medicaid/Uninsured in the third row of Table 5) and their respective excess health-cost estimates (rows 4 and 5 of Table 5). Over this time period, the measure of the economic cost of excess health care use is over \$501 million for Cabell County.

⁸⁵ Florence, *et al.*, *op. cit.*, Table 2.

⁸⁶ D. Leslie, *et al.*, “The Economic Burden of the Opioid Epidemic on States: The Case of Medicaid,” *American Journal of Managed Care*, June 2019, Supplement 25(13), pp. S243-249.

⁸⁷ Davenport, *et al.*, *op. cit.*

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Table 5
Morbidity and Excess Health Care Costs Attributed to the
Sales and Distribution of Prescription Opioids
Cabell County, 2006-2018

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Total OUD cases due to prescription opioids	3,859	5,952	3,433	3,773	4,985	6,230	3,530	7,218	6,020	7,240	7,148	9,018	7,109	75,515
Share of OUD cases covered by Medicare/Commercial payers	43.6%	39.0%	43.8%	43.8%	39.3%	40.9%	38.9%	37.7%	34.9%	34.5%	34.4%	32.0%	32.0%	
Share of OUD cases covered by Medicaid/Uninsured	56.4%	61.0%	56.3%	56.3%	60.7%	59.1%	61.1%	62.3%	65.1%	65.5%	65.6%	68.0%	68.0%	
Excess health care costs per OUD case covered by Medicare/Commercial payers	\$13,567	\$12,914	\$11,761	\$11,781	\$12,017	\$10,866	\$10,344	\$8,878	\$8,878	\$8,878	\$8,878	\$8,878	\$8,878	
Excess health care costs per OUD case covered by Medicaid/Uninsured	\$6,044	\$5,753	\$5,240	\$5,249	\$5,354	\$4,841	\$4,609	\$3,955	\$3,955	\$3,955	\$3,955	\$3,955	\$3,955	
Total excess health care costs due to prescription opioids (\$ mil)	\$36.0	\$50.9	\$27.8	\$30.6	\$39.8	\$45.5	\$24.2	\$41.9	\$34.2	\$40.9	\$40.4	\$49.9	\$39.3	\$501.3

Source: Keyes Report, Figure 14 and Appendix C, Tables C.II.4 and C.II.5

55. My valuation of the excess cost of health care treatment for people with OUD due to prescription opioids underestimates the full cost of OUD morbidity to the Cabell Huntington Community. Local governments, partly with grant support, community organizations, and in some cases private citizens, pay for health care and other social services. Programs in Huntington include the Provider Response Organization and Addiction Care and Treatment (PROACT), a facility that provides housing, social and clinical support, as well as Medication for Opioid Use Disorder (MOUD)⁸⁸ for its patients.⁸⁹ Drug overdoses strained first-responders' capacity.⁹⁰ Figures 4a and 4b, taken from material prepared by Scott Lemley, the Executive Director of the Department of Development and Planning at the City of Huntington, and

⁸⁸ MOUD was formerly referred to as MAT (Medically Assisted Treatment). See National Council for Behavioral Health, "Medication-Assisted Treatment (MAT) for Opioid Use Disorder in Jails and Prisons," January 2020d (<https://www.thenationalcouncil.org/medication-assisted-treatment-for-opioid-use-disorder-in-jails-and-prisons/>).

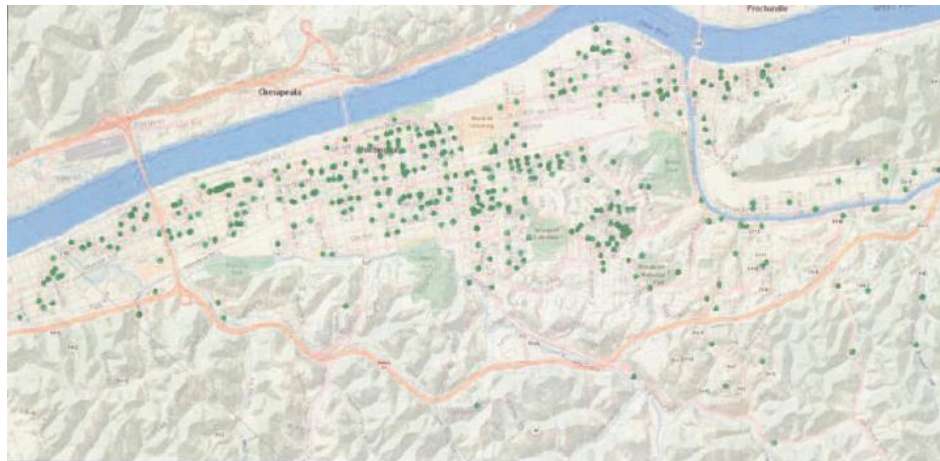
⁸⁹ The City of Solutions, Huntington WV, pp. 39-40.

⁹⁰ "...overdoses were a big issue. Responding to them, I think they felt -- I don't want to say 'helpless,' but first responders are problem solvers, and I think they felt like it was a problem they couldn't solve, and again, it caused compassion fatigue, burnout..." (Lemley Deposition, p. 31).

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previously a Crime Intelligence Analyst for the Huntington Police Department, are maps showing the incidents and concentration of non-fatal drug overdoses in Huntington in one year, 2016. Lemley explains regarding the two figures: “So you have a dot every time there was an incident of a nonfatal overdose. And ... it gets kind of tricky because you have dots on top of dots on top of dots if they’re at the same address, so it can be difficult to see, which is why we did the heat map, as we say, showing concentrations.”⁹¹ On the heat map the red areas have higher concentrations than the yellow and green areas.

Figure 4a
Incidence Map: Non-Fatal Drug Overdoses in Huntington, 2016⁹²

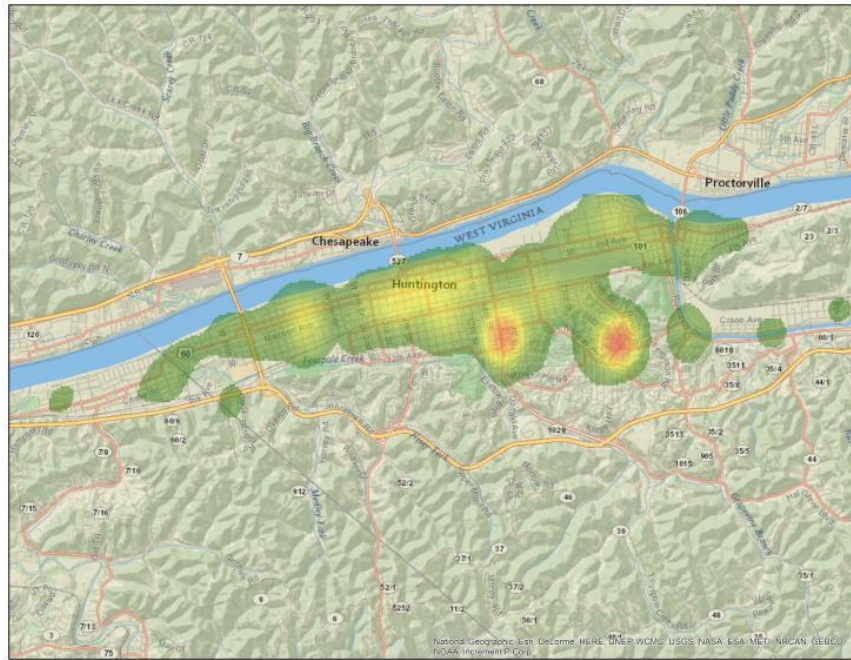


⁹¹ Lemley Deposition, pp. 330-333, quote from p. 333. Referencing Deposition Exhibit 1. The exhibit, “The Huntington Model: How One West Virginia City is Fighting Back Against Opioids,” also includes data on the number of nonfatal overdoses in Cabell County for 2015 (874 cases) and 2016 (1,404 cases).

⁹² Note that these overdoses include prescription and non-prescription opioids.

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Figure 4b
Heat Map: Non-Fatal Drug Overdoses in Huntington, 2016⁹³



Prescription Opioids and Workforce Productivity

56. Pain from injury can interfere with an individual's ability to work,⁹⁴ and reductions in pain enable some to work who would have otherwise been prevented from working due to pain.⁹⁵ A study of the effects of Cox-2 inhibitors (non-opioid pain medications) finds that treatment increases workplace attendance.⁹⁶ Opioids are medically indicated for severe pain associated

⁹³ Note that these overdoses include prescription and non-prescription opioids.

⁹⁴ D.J. Gaskin and P. Richard, "The Economic Cost of Pain in the United States," *Journal of Pain*, 13(8), 2012, pp. 715-724.

⁹⁵ Participation in the labor force benefits the individual and the wider society. The individual benefits to the degree that added income adds to their consumption opportunities. Others benefit to the degree that the added income of the worker increases public tax revenue or offsets costs others would have paid to support consumption of the individual had they been out of the labor force. For example, those outside of the labor force are paid unemployment or disability benefits; avoiding these transfer payments benefits the public. Support for an individual out of the labor force may come from other family members, and this support is not needed if an individual is working and supporting themselves. In other words, how much of the benefits of labor force participation flow directly to the worker or to others depends on the individual circumstances.

⁹⁶ Cox-2 inhibitors are not generally used for recreational purposes. See C. Garthwaite, "The economic benefits of pharmaceutical innovations: The case of cox-2 inhibitors," *American Economic Journal: Applied Economics*, 4(3), 2012, pp. 116-137. A. Butikofer and M. M. Skira, "Missing Work is a Pain: The Effect of Cox-2 Inhibitors on Sickness Absence and Disability Pension Receipt," *Journal of Human Resources*, 53(1), 2018, pp. 71-122.

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with trauma, post-surgery, and cancer end-of-life care, conditions for which pain reduction may not have a large effect on labor force participation.⁹⁷ Nonetheless, it is at least theoretically possible that in some instances, additional appropriate opioid prescriptions could increase productivity.

57. Prescription opioids are associated with numerous adverse consequences with increasing dose and duration of use, including development of OUD but also death, morbidity, crime, incarceration, and child maltreatment, all of which decrease labor force participation of the user and/or of others in the immediate and longer term. A working paper from the National Bureau of Economic Research studied the effect of opioid prescriptions on workers out on temporary disability with low-back pain. Long-term treatment with opioids increased the length of time workers missed work due to disability.⁹⁸

58. Some recent papers in the economics literature study the effect of opioid prescriptions on a geographic basis (rather than for populations who might be candidates for appropriate treatment), and thus capture empirically both the positive effects (from worker pain treatment) and some negative effects (from inappropriate treatment) of opioid prescriptions on work.⁹⁹ As one set of authors put it, “Because it is impossible to distinguish between legitimate and illegitimate uses of prescription opioids, we interpret these [geographic-level] results as a net effect of both types of use.”¹⁰⁰ These authors found that the net effect of prescribing on

⁹⁷ Lembke Report, Appendix IV, p.253. Further, CDC provides guidance on the use of prescription opioids for pain relief outside of palliative, cancer, or end-of-life care. These guidelines recommend the use of non-opioid analgesics for chronic pain management and emphasize patient safety from addiction. See D. Dowell, T.M. Haegerich, and R. Chou, “CDC Guidelines for Prescribing Opioids for Chronic Pain – United States, 2016,” *JAMA*, 315(15), 2016, pp. 1624-1645.

⁹⁸ B. Savych, D. Neumark and R. Lea, “Do Opioids Help Injured Workers Recover and Get Back to Work? The Impact of Opioid Prescriptions on the Duration of Temporary Disability,” National Bureau of Economic Research, Cambridge, MA, April 2018.

⁹⁹ M.C. Harris, *et al.*, “Prescription Opioids and Labor Market Pains: The Effect of Schedule II Opioids on Labor Force Participation and Unemployment,” working paper, March 28, 2018, pp. 1-44 at p. 1 (https://mpira.ub.uni-muenchen.de/86586/1/MPRA_paper_86586.pdf); A. Krueger, “Where Have All the Workers Gone? An Inquiry into the Decline of the U.S. Labor Force Participation Rate,” Brookings Papers on Economic Activity, 2017; and J. Currie, J. Jin, and M. Schnell, “U.S. Employment and Opioids: Is There a Connection?” in *Health and Labor Markets*, Research in Labor Economics, Volume 47, 2019, Emerald Publishing Limited.

¹⁰⁰ Harris, *et al.*, *op. cit.*

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productivity at the state level was negative.¹⁰¹ One paper using county data on prescription rates and employment by age and gender finds that a higher rate of prescriptions has a small positive effect on employment for women, but no effect on men.¹⁰² Finally, a recent paper finds that increasing prescription opioid prescribing rates decreases the prime-age employment rate for both men and women.¹⁰³

59. A paper sponsored by the American Action Forum can be used as a basis for quantifying the loss in output associated with prescription opioids. Krueger found that areas with higher opioid prescription rates have lower rates of labor force participation overall.¹⁰⁴ A follow up analysis by the Forum updated the Krueger paper and calculated the reduction in workforce and output for each state.¹⁰⁵ West Virginia was among the hardest hit states because of the massive state-wide growth in opioid prescriptions.¹⁰⁶ According to the report, the largest negative economic effects in the country occurred in Arkansas and West Virginia, “where the prime-age labor force participation rate declined by 3.8 percentage points and the real economic growth rate slowed by 1.7 percentage points.” This research, and the others mentioned in this and the previous two paragraphs, are summarized and compared in more detail in Table C.II.7 of Appendix C.

60. On the basis of the available evidence, I am of the opinion that the net effect of the sales and distribution of prescription opioids on labor productivity is negative: more prescriptions

¹⁰¹ Harris, *et al.*, *op. cit.* study ten states using data from Prescription Drug Monitoring Programs and find that a 10% increase in per capita prescriptions leads to a 0.56 percentage point decrease in labor force participation.

¹⁰² Currie, Jin, and Schnell, *op. cit.*

¹⁰³ D. Aliprantis, K. Fee, and M.E. Schweitzer, “Opioids and the Labor Market,” *Federal Reserve Bank of Cleveland*, Working Paper No. 18-07, 2019.

¹⁰⁴ Krueger, *op. cit.*

¹⁰⁵ American Action Forum, “State-By-State: The Labor Force and Economic Effects of the Opioid Crisis,” September 12, 2018 (<https://www.americanactionforum.org/project/opioid-state-summary/west-virginia/>). The new report also corrects for an interpretation error in the original Krueger analysis associated with non-linear properties of his regression specification. When the interpretation is corrected, “the regression indicates that growth in opioids led the nationwide prime-age labor force participation rate to decline by 1.4 percentage points for men (40 percent of the total decline) and 1.8 percentage points for women (nearly 60 percent of the total decline).” This effect is about twice as large as contained in Krueger’s analysis.

¹⁰⁶ The CDC has IQVIA data on per-capita opioid prescribing rates. From 2006-2011, West Virginia had the highest rate in the nation. From 2012-2014, it had the second highest rate; in 2015, the fourth. In 2016 and 2017, it was the 8th highest. See CDC, “U.S. Opioid Prescribing Rate Maps” (<https://www.cdc.gov/drugoverdose/maps/rxrate-maps.html>) for data and details.

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mean less work. This conclusion is bolstered by the observation that the short-term harms of the sales and distribution of prescription opioids on workforce productivity underestimate the full negative effects which play out over time. A worker who develops OUD today because of prescription opioids may have reduced labor-force participation, on average, for years to come.

61. Experience in the Community accords with the research studies. I have not undertaken a quantification of the longer-term effects on productivity from the sales and distribution of prescription opioids (apart from death, criminality, and child maltreatment). But given the dynamics of opioid use and OUD, measurement of these longer-term effects on productivity from sales and distribution of prescription opioids would result in a much greater imbalance where the costs far exceed the benefits in productivity.

62. The overall purpose of my analysis here is to determine whether overall costs from the sales and distribution of prescription opioids exceed ostensible benefits. As a result, if a particular quantification is not needed to make that determination, I can simplify the analysis by making conservative assumptions. Therefore, even though I believe costs to workforce productivity outweigh the benefits, when counting and valuing the effects of prescription opioids on workforce productivity, I will conservatively treat the positive and negative as approximately canceling out.

63. My opinion that the costs of prescription opioids in terms of workforce participation outweigh the potential benefits is complemented by the opinions of medical experts regarding the clinical costs and benefits. Dr. Lembke, a physician who has treated many patients with OUD, addresses the issue of benefits of prescription opioids in relation to alternative treatments and concludes that “the best available evidence ... found that non-opioid medications (NSAIDs, acetaminophen) provide equivalent or greater pain relief, while opioids confer significantly greater risks ...”¹⁰⁷ Dr. Lembke also discusses a systematic literature review which concludes that prescription opioids fare poorly even in relation to placebo (*i.e.*, no) treatment. The review found “that the difference in pain relief did not meet a pre-specified

¹⁰⁷ Lembke Report, pp. 254 – 255.

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‘Minimally Important Difference’ (MID), that is, ‘the smallest amount of improvement in a treatment outcome that patients would recognize as important.’”¹⁰⁸

64. Dr. Lembke states:¹⁰⁹

“Based on the consensus view stated in the NASEM [National Academies of Sciences, Engineering, and Medicine] Report, research findings, and my own clinical experience, it is my view that **at a population level**, the risks of long-term opioids for chronic pain far outweigh the benefits. For very few patients, benefits might outweigh the risks; but even then risks increase with higher dose and longer duration of opioid treatment, such that risks may eventually exceed any small possible benefit over other less dangerous pain reduction strategies.” (emphasis added)

65. Dr. Lembke goes on to state her conclusions as follows:¹¹⁰

“The adverse effects of opioids are well-known and devastating. These include overdose mortality, primarily due to respiratory suppression; non-fatal overdose; OUD; and neonatal abstinence syndrome (NAS), which afflicts newborns well into childhood. These conditions are severe, fatal or life-threatening, permanent or of long duration. The Cabell Huntington Community has been even more severely impacted than the US as a whole.

In contrast, the benefits of prescription opioids are limited or ephemeral. I agree with the consensus of leading authorities that there is no reliable evidence that long-term opioids provide clinically significant relief of CNCP, and the best evidence supports equivalent pain relief and fewer risks with non-opioids such as NSAIDs. Although opioids are indicated for acute pain, numerous studies show equivalent relief and lower risk with non-opioids; a significant minority of acute-pain opioid patients go on to become persistent users who suffer dependency but do not benefit from opioid use; over-prescribing for acute conditions results in diversion to inappropriate users, a source of community harm that further offsets any pain relief benefits to appropriate users; and the pain relief in acute conditions is inherently brief, compared to the long-term or permanent harms of fatal and non-fatal overdose, OUD and NAS.

In summary, it is my clinical opinion that the harms of prescription opioids to the Cabell Huntington Community far outweigh any benefits that may be conferred.”

¹⁰⁸ Lembke Report, p. 254. See J.W. Busse, *et al.*, “Opioids for Chronic Noncancer Pain: A Systematic Review and Meta-Analysis,” *JAMA*, 320(23), 2018, pp. 2448-2460.

¹⁰⁹ Lembke Report, p.255. Dr. Lembke’s reference in this quotation is to: National Academies of Science Engineering and Medicine (NASEM), “Pain Management and the Opioid Epidemic: Balancing Societal and Individual Benefits and Risks of Prescription Opioid Use,” 2017, p. 51.

¹¹⁰ Lembke, Appendix IV, p. 261.

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66. See also the Report of Dr. Waller, a practicing addiction, pain, and emergency medicine physician, where he discusses the limited clinical situations in which opioids are a medically appropriate option, and the very substantial medical risk incurred by prescription opioid use.¹¹¹

C. Babies Born with Neonatal Abstinence Syndrome (NAS)

Overview

67. Neonatal abstinence syndrome (NAS), also termed neonatal withdrawal,¹¹² is a constellation of conditions associated with *in utero* exposure to opioids.¹¹³ It can occur due to any regular antenatal opioid use, including whether opioids are taken as prescribed or non-medically.¹¹⁴ According to the CDC, “Neonatal abstinence syndrome (NAS) is a postnatal drug withdrawal syndrome in newborns caused primarily by *in utero* exposure to opioids.”¹¹⁵

68. The syndrome is a rapidly growing public health problem, with the incidence of NAS increasing dramatically between 2000-2012, corresponding with a rise in opioid use and abuse.¹¹⁶ Babies born with NAS may exhibit a host of symptoms, including respiratory distress;

¹¹¹ Expert Report of Dr. Corey Waller, in this matter, August 3rd, 2020 (hereafter Waller Report). Dr. Waller rejects opioids as an appropriate treatment choice for chronic pain management and considers them a risky treatment course in intra-operative and post-surgical settings, concluding that “...except for pain treatment in severe acute trauma, palliative care, and hospice treatment, opioids should be considered the approach of last resort when treating patients with acute or chronic pain (p. 40).” Dr. Waller characterizes palliative care and hospice as the “core scope under which opioids may be used appropriately” (p. 39). “Balancing opioids’ severe risks with the lack of efficacy of opioids to treat chronic pain makes it obvious that opioids are of little to no use in chronic pain and should be used sparingly, if at all, to treat pain lasting more than 3-7 days” (p. 39). In page 23 of his report, Dr. Waller describes the “serious, severe and predictable” risks associated with the drugs at issue in this matter: “addiction, dependence, tolerance, withdrawal, respiratory depression, overdose, and death”

¹¹² K. McQueen and J. Murphy-Oikonen, “Neonatal Abstinence Syndrome,” *New England Journal of Medicine*, 375(25), 2016, pp. 2468-2479.

¹¹³ H. Uebel, *et al.*, “Reasons for Rehospitalization In Children Who Had Neonatal Abstinence Syndrome,” *Pediatrics*, 136(4), 2015, pp. e811-e820.

¹¹⁴ S. Wong, *et al.*, “Substance Use in Pregnancy,” *Journal of Obstetrics and Gynecology Canada*, 33(4), 2011, pp. 367-384.

¹¹⁵ CDC, “Incidence of Neonatal Abstinence Syndrome – 28 States, 1999-2013,” *Morbidity and Mortality Weekly Report (MMWR)*, 65(31), August 12, 2016, pp. 799-802 at p. 801 (<https://www.cdc.gov/mmwr/volumes/65/wr/mm6531a2.htm>).

¹¹⁶ S.W. Patrick, *et al.*, “Neonatal Abstinence Syndrome and Associated Health Care Expenditures: United States, 2000-2009,” *JAMA*, 307(18), 2012, pp. 1934-1940; S.W. Patrick, *et al.*, “Increasing Incidence and Geographic Distribution of Neonatal Abstinence Syndrome: United States 2009 to 2012,” *Journal of Perinatology*, 35(8), August 2015, pp. 650-655.

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central nervous system symptoms like tremors and seizure; and gastrointestinal problems such as poor feeding and vomiting.¹¹⁷ The onset of symptoms typically occurs within the first few days following birth.¹¹⁸

69. Calculating the harm from babies born with NAS in the Cabell Huntington Community and attributable to prescription opioids is based on multiplying the number of NAS cases due to prescription opioids by the economic costs associated with an NAS birth. I consider three types of excess economic costs due to NAS: hospital costs at birth, health care costs during childhood, and special education costs. I describe the rationale for each of these cost categories below.

70. The NAS epidemic has prompted a forceful response from the Cabell Huntington Community. One example is Lily's Place, which opened in Huntington in October 2014.¹¹⁹ Lily's place "provides short-term medical care to infants suffering from prenatal drug exposure and offers non-judgmental support, education, and counseling to families," and has become a regional and national resource for care of NAS babies.¹²⁰ NAS babies come to Lily's Place directly after leaving the hospital. Lily's Place spends more than \$1 million caring for infants with NAS each year since 2016.¹²¹

71. Figure 7 compares the NAS rate in Cabell County to the West Virginia and national rates, which are supplied by Professor Keyes.¹²² West Virginia has a much higher rate than the nation overall, and Cabell has a rate higher still than the West Virginia average rate. Between 2013 and 2015, the rate of NAS births was more than 500% greater in Cabell County than nationwide.

¹¹⁷ S. Wong, *et al.*, *op. cit.*, Table 6.

¹¹⁸ S. Wong, *et al.*, *op. cit.*, p. 375.

¹¹⁹ Lily's Place, Inc., Annual Financial Report, 2017 (HUNT_00197045-55 and <https://lilysplace.org/about>). See also, The City of Solutions, Huntington WV, pp. 43-44.

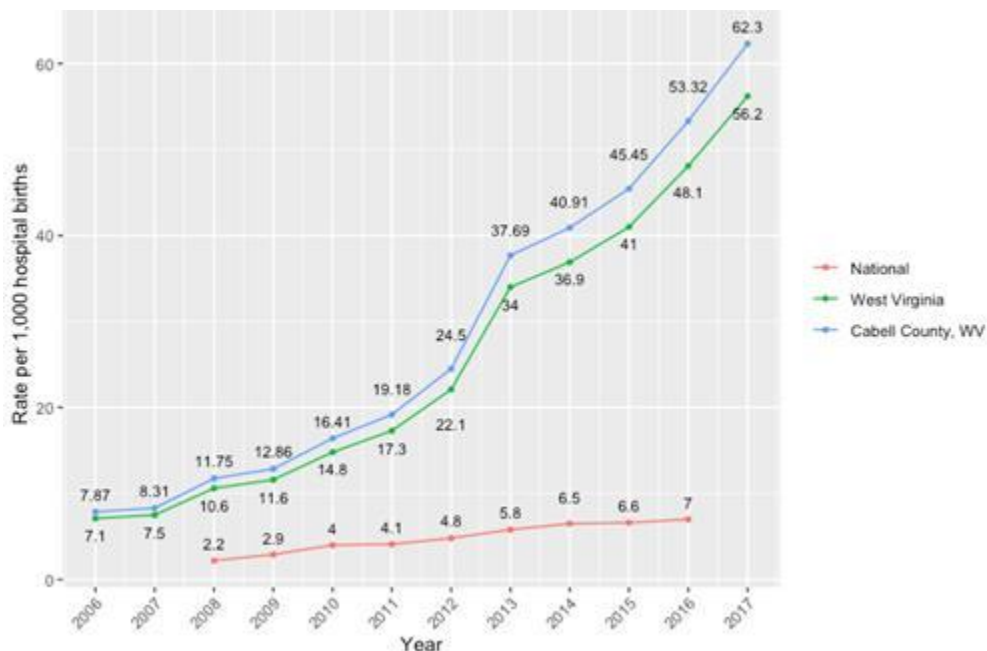
¹²⁰ Lily's Place, *op. cit.*, p. 6.

¹²¹ Financial details of Lily's Place come from ProPublica's nonprofit Explorer (<https://projects.propublica.org/nonprofits/organizations/462235123>). In, 2017, for example, Lily's Place spent \$1.2 million.

¹²² Keyes Report, Figure 10.

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Figure 7
NAS Cases per 1,000 Hospital Births
National, West Virginia and Cabell County Rates
Replication of Keyes Report, Figure 10



Count of Births with NAS

72. To identify the number of NAS babies in Cabell County, I rely on Professor Keyes. Professor Keyes states: “The majority of neonatal abstinence syndrome among US infants is due to opioid exposure in utero.”¹²³ On this basis I conservatively attribute 50% of her estimated number of NAS births in Cabell County to opioids.¹²⁴ She provides estimates of the number of NAS births attributable to opioid use for the years 2006-2015, but not for 2016-2018 due to data unavailability. To estimate to the number of NAS births attributable to prescription opioids, I assume the share of NAS births due to prescription opioids is the same as the share of OUD due to prescription opioids. Specifically, I use the last row from Table 4 above to determine the number of NAS births due, directly or indirectly, to prescription opioids. Table 6 presents the counts for NAS due to prescription opioids in Cabell County.

¹²³ Keyes Report, p. 36.

¹²⁴ Keyes Report, Table 1.

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Table 6
NAS Births Due to Prescription Opioids in Cabell County
2006-2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Cabell County NAS cases	10.0	10.0	15.0	16.0	19.0	23.0	30.0	44.0	46.0	49.0	262.0
Cabell County NAS cases due to opioids	5.0	5.0	7.5	8.0	9.5	11.5	15.0	22.0	23.0	24.5	131.0
Share of NAS cases due to prescription opioids	97%	97%	99%	99%	98%	98%	94%	94%	90%	88%	
Cabell County NAS cases due to prescription opioids	4.9	4.9	7.4	7.9	9.3	11.3	14.1	20.6	20.7	21.5	122.6

Sources: Keyes Report, Table 1, and Table 4 above.

Valuation of Excess Costs of NAS

73. A baby born with NAS is more likely to have elevated health care costs at birth,¹²⁵ higher levels of morbidity and rehospitalization through childhood,¹²⁶ increased risk of educational disability,¹²⁷ development delay,¹²⁸ and poor school performance.¹²⁹ NAS births are associated with more intensive hospital utilization than other births, including, for example, increased length of stay and increased risk of transfer to the neonatal intensive care unit, resulting in higher costs.¹³⁰ Later in life, children born with NAS are more likely to suffer mental and physical trauma, endure maltreatment, develop ophthalmologic conditions, behavioral disorders, and

¹²⁵ S.W. Patrick, *et al.*, *op. cit.*; American College of Obstetricians and Gynecologists, “Opioid Use and Opioid Use Disorder in Pregnancy. Committee Opinion No. 711,” *Obstetrics & Gynecology*, 130(2), 2017, pp. e81-e94.

¹²⁶ G. Liu, *et al.*, “A Longitudinal Healthcare Use Profile of Children with A History of Neonatal Abstinence Syndrome,” *The Journal of Pediatrics*, 204, 2019, pp. 111-117.

¹²⁷ M.M. A Fill, *et al.*, “Educational Disabilities Among Children Born with Neonatal Abstinence Syndrome,” *Pediatrics*, 142(3), 2018, p. e20180562.

¹²⁸ E.S. Hall, J.M. McAllister, and S.L. Wexelblatt, “Developmental Disorders and Medical Complications Among Infants with Subclinical Intrauterine Opioid Exposures,” *Population Health Management*, 22(1), 2019, pp. 19-24.

¹²⁹ J.L. Oei, *et al.*, “Neonatal Abstinence Syndrome and High School Performance,” *Pediatrics*, 139(2), 2017, p. e20162651.

¹³⁰ S. Wong, *et al.*, *op. cit.* See also: T.E. Corr and C.S. Hollenbeak, “The Economic Burden of Neonatal Abstinence Syndrome in the United States,” *Addiction*, 112, 2017, pp. 1590-1599.

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suffer preventable injuries that require care and in some cases repeat hospitalizations.¹³¹ I focus on excess health care costs during childbirth and childhood, and excess costs incurred for special education. Data are not available for excess costs later in life.

74. I begin with excess hospital costs associated with an NAS delivery. Hospital discharge data reports “charges,” a form of list price that is generally not what health care payers actually pay. To quantify the excess hospital costs due to NAS, I begin with the difference between the average hospital charge for an NAS case in West Virginia and the average hospital charge for all births¹³² in the state in each year. I then convert excess hospital charges to excess hospital costs by multiplying charges by net revenue-to-charge ratios from the American Hospital Association. This adjustment, in effect, transforms charges into costs to payers (which equals revenue to the hospital). Table 7 reports the total estimated hospital costs of NAS attributable to prescription opioid sales; these costs were over \$1.4 million in Cabell County between 2006-2015. See Appendix C Section III for information about the estimate of hospital costs.

¹³¹ H. Uebel, *et al.*, *op. cit.* Professor Keyes discusses the adverse downstream consequences at length in her report (Keyes Report, p. 36).

¹³² Note that the average charge for all births include charges for NAS making my calculation conservative as NAS-related charges are higher than non-NAS related charges.

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Table 7
Neonatal Abstinence Syndrome (NAS) and Valuation
Due to Sales and Distribution of Prescription Opioids
Cabell County, 2006-2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
NAS cases in Cabell County	10.0	10.0	15.0	16.0	19.0	23.0	30.0	44.0	46.0	49.0	262.0
NAS cases attributed to prescription opioids	4.9	4.9	7.4	7.9	9.3	11.3	14.1	20.6	20.7	21.5	122.6
Excess hospital costs for NAS births	\$11,083	\$10,848	\$15,785	\$34,357	\$56,742	\$109,151	\$199,535	\$266,558	\$316,755	\$375,693	\$1,396,506
Excess child health care cost for NAS cases	\$44,413	\$44,422	\$67,520	\$72,024	\$84,802	\$102,671	\$128,228	\$188,127	\$188,971	\$195,764	\$1,116,943
Excess special education costs for NAS cases	\$3,533	\$3,534	\$5,372	\$5,730	\$6,747	\$8,168	\$10,202	\$14,967	\$15,034	\$15,575	\$88,862
Total NAS excess costs due to prescription opioids (\$million)	\$0.06	\$0.06	\$0.09	\$0.11	\$0.15	\$0.22	\$0.34	\$0.47	\$0.52	\$0.59	\$2.60

Sources: Keyes Report, Table 1 and Appendix C, Tables C.III.1 - C.III.3

75. Turning to excess health care costs during childhood due to NAS, Liu, *et al.* find, in a privately insured national population in 2005-2014, that children ages 1-8 born with NAS incur an average of \$6,927 per year in health care costs, compared to \$2,735 for those without, implying an annual excess health care cost of \$4,192 for children born with NAS.¹³³ Most children born with NAS are covered by Medicaid.¹³⁴ I adjust the Liu, *et al.* estimates downward to reflect lower Medicaid costs and lower costs in West Virginia using the same approach as in the morbidity section above.¹³⁵ Applying these adjustments to determine an annual excess health care cost for children born with NAS in West Virginia, and then multiplying by 8 years for years yields excess health care costs of \$9,113 per child with NAS. This estimate is conservative in that the health care costs from the Liu, *et al.* study include earlier years than the 2006-2015 years

¹³³ G. Liu, *et al.*, *op. cit.* These costs include hospitalizations, emergency department visits, outpatient evaluations, and prescription drugs.

¹³⁴ S.W. Patrick, *et al.*, *op. cit.*

¹³⁵ Medicare/Commercial costs for OUD were 224.5% higher relative to Medicaid/Uninsured. Moreover, West Virginia Medicaid costs for OUD were 39% lower than the national average.

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addressed in my Report. These excess health care costs amount to \$1.1 million from 2006-2015 in Cabell County.

76. Children born with NAS are also more likely to incur additional educational expenses, in the form of evaluation for disabilities, use of speech or other developmental therapy, and other services.¹³⁶ Fill, *et al.* estimate that children with NAS in Tennessee are 3.9 percentage points more likely to receive special education services and therapy (15.3% versus 11.4%).¹³⁷ Based on the academic literature, I estimate that the average cost of services provided to special education students is approximately \$9,298 per year.¹³⁸ Students receive an average of two years of special education.¹³⁹ Multiplying these variables results in an estimate of \$725 in average excess educational cost per student with NAS.¹⁴⁰ These costs add \$0.09 million to the total costs to the Cabell Huntington Community attributable to prescription opioids over the years 2006-2015. See Appendix C Section III for a detailed description of methods and sources used for these calculations.

77. My valuation of the cost of NAS is conservative. First, as explained above, data are not available to provide estimates for the years 2016-2018. Figure 7 above shows a steep, upward trend in the NAS rate in Cabell County, in parallel to West Virginia. This suggests that the NAS rate in Cabell County would also have gone up over these latter years. My valuation does not include some costs after the baby is discharged from the hospital, including Cabell Huntington Community efforts for children born with NAS and their families. Furthermore, because of data limitations, I omit some categories of excess costs due to NAS. For example, children born with NAS have worse health outcomes into early adulthood.¹⁴¹ Higher health care costs might persist

¹³⁶ J.L. Oei, *et al.*, *op. cit.*

¹³⁷ M.M.A. Fill, *et al.*, *op. cit.*

¹³⁸ See Appendix C for details on how I derive this valuation.

¹³⁹ E.W. Holt, D.J. McGrath, and W.L. Herring, "Timing and Duration of Student Participation in Special Education in the Primary Grades," NCES, 2007-043, Washington DC, National Center for Education Statistics, 2007.

¹⁴⁰ $(\$9,298) * 2 * 0.039 = \725 .

¹⁴¹ H. Uebel, *et al.*, *op. cit.*

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after age 8,¹⁴² but I am not aware of research on which to base a quantitative calculation of ongoing excess health care costs. Evidence suggests that children born with NAS have lower educational outcomes later in life and underperform in school.¹⁴³ The positive relationship between education and income is well-known, implying a cost to the children in terms of lower income, fewer economic opportunities and reduced upward mobility.¹⁴⁴ Moreover, education levels are inversely correlated with participation in criminal activities, and drug use.¹⁴⁵ Finally, the long-term adverse consequences of NAS are unknown and as such there are no data of which I am aware to quantify the long-term economic damages to a generation with so many babies born with NAS.

D. CrimeOverview

78. The sales and distribution of prescription opioids increase crime through a number of causal channels. For example, the resale of prescription opioids (*e.g.*, OxyContin) is a crime. Additionally, people misusing opioids may commit crimes, such as property theft, to obtain money to buy opioids or their drug use may lead to other crimes, such as assault.¹⁴⁶

79. My approach for valuing the economic harm of criminal activity in the Cabell Huntington Community due to prescription opioids is as follows. First, I obtain local crime data, from which

¹⁴² Two literature reviews find scant research on the longer-term consequences from children born with NAS. See D.J. Maguire, S. Taylor, K. Armstrong, *et al.*, “Long-Term Outcomes of Infants With Neonatal Abstinence Syndrome,” *Neonatal Network*, 35(5), 2016, pp. 277-286 and H.J. Harder and A.Z. Murphy, “Early Life Opioid Exposure and Potential Long-Term Effects,” *Neurobiology of Stress*, 10, 2019, p. 100156.

¹⁴³ J.L. Oei, *et al.*, *op. cit.*

¹⁴⁴ D. Card, “The Causal Effect of Education on Earnings,” *Handbook of Labor Economics*, 3, Elsevier, 1999, pp. 1801-1863.

¹⁴⁵ L. Lochner and E. Moretti “The Effect Of Education on Crime: Evidence From Prison Inmates, Arrests, and Self-Reports,” *American Economic Review*, 94(1), 2004, pp. 155-189; P. Chatterji, “Illicit Drug Use and Educational Attainment,” *Health Economics*, 15(5), 2006, pp. 489-511.

¹⁴⁶ T.N.A. Winkelman, V.W. Chang, and I.A. Binswanger, “Health, Polysubstance Use, and Criminal Justice Involvement Among Adults with Varying Levels of Opioid Use,” *JAMA Open Network*, 1(3), 2018, pp. e180558-e180558; R. N. Hansen, *et al.*, “Economic Costs of Nonmedical use of Prescription Opioids,” *The Clinical Journal of Pain*, 27(3), 2011, pp. 194-202.

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I derive a share of crime due to prescription opioids. Second, I take these counts and multiply by crime cost valuations from the research literature based on the type of offense.

80. In Huntington, local officials attest that opioids drive crime. In 2017, in reporting in *The Herald Dispatch* by Courtney Hessler, Captain Hank Dial stated that many of the city's crime problems "stem from drug trafficking ..." ¹⁴⁷ In other reporting by Hessler in *The Herald Dispatch*, according to Chief of Police Joe Ciccarelli: "If you aren't involved in drugs, the chance of being a victim of violent crimes is pretty slim ..." ¹⁴⁸ The Chief went on to say, "It's common we have drug robberies.... When we say the victim isn't cooperating, there's a reason. They will take their licks and go on. Oftentimes, there are retaliation shootings." ¹⁴⁹ City of Huntington Mayor Williams was aware of this relationship years before. When asked as to his awareness of an opioid problem prior to 2014, he responds: "The City had a problem with several different drugs. In 2014, I became aware that opioids was more than just a problem; that it was driving ... the extent of the drug trade, the crime and other problems within the City. And that's when ... I received a heightened awareness of the extent of the opioid epidemic." ¹⁵⁰

81. Drug crimes in the Cabell Huntington Community increased dramatically in step with the opioid epidemic. Figures 8a and 8b depict the "hot spots" of drug offenses for 2004 and 2014 in Huntington. High-crime areas got hotter, and the heat spread throughout the city over this ten-year period. ¹⁵¹ In his deposition, Scott Lemley, creator of the heat maps, describes what they show: "What you see in 2004 was in the Fairfield neighborhood. It was known for dealing of drugs, drug possession, violent crimes... as you move from 2004 to '14, it literally went from a

¹⁴⁷ J. Qualls, and C. Hessler, "Leaders Address Public Safety Concerns with 'Show of Force,'" *The Herald-Dispatch*, December 13, 2017 (www.herald-dispatch.com/_recent_news/leaders-address-public-safety-concerns-with-show-of-force/article_355de5bc-dfb1-11e7-be5a-c7043283e7a3.html?fbclid=IwAR3YrbSmcAqQkODyZCS4IGZWe2T5CvEdZQ_wlyRLQfP_ljD5YF5dd4tVIJQ#utm_campaign=blox&utm_source=facebook&utm_medium=social).

¹⁴⁸ C. Hessler, "Violent Crime Rate in City Grew in 2016," *The Herald-Dispatch*, March 12, 2017 (www.herald-dispatch.com/news/violent-crime-rate-in-city-grew-in-2016/article_44a5b63f-cc4e-56b0-a7b6-db3fbfe4d70f.html).

¹⁴⁹ *Ibid.*

¹⁵⁰ Deposition of Steve Williams, in this matter, June 30, 2020 (hereafter Williams Deposition), p. 24.

¹⁵¹ Lemley Deposition, pp. 329-330.

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very small area to touching almost every neighborhood in Huntington...it permeated from a geographic standpoint, everywhere.”¹⁵²

Figure 8a
Drug Offenses Heat Maps, Huntington
2004

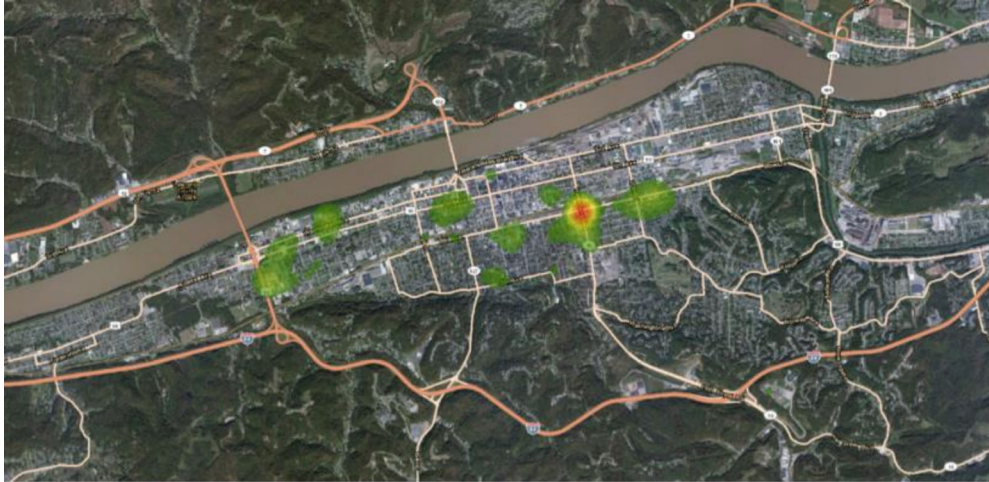
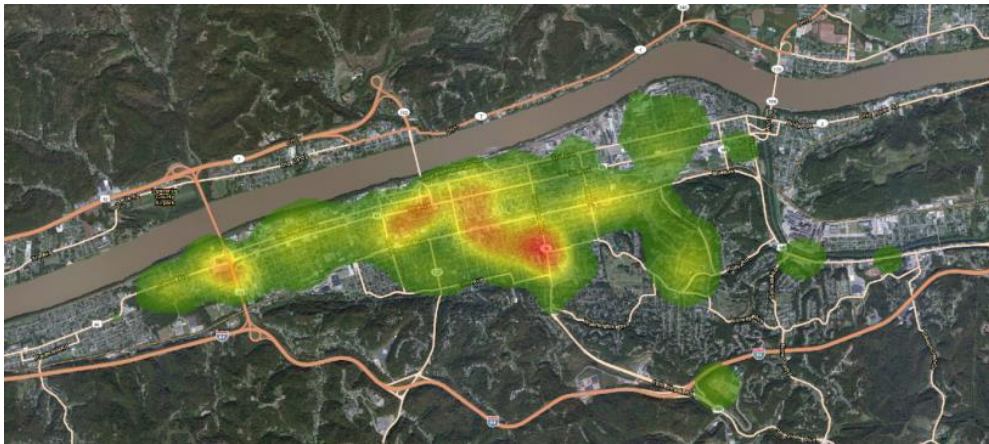


Figure 8b
Drug Offenses Heat Maps, Huntington
2014



¹⁵² *Ibid.*

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82. In response to the wave of criminal activity due to drugs, the Huntington Mayor's Office of Drug Control and Policy was established to fight the harm due to drug addiction in Huntington.¹⁵³ The office enhances ties with federal law enforcement agencies, and promotes surveillance of drug dealers through the justice system.

83. As noted above at ¶¶ 29 and 35, the valuation of crimes presented here based on the research literature does not include a measure of the stress imposed on first responders among the police, fire and EMS units.

Count of Crimes

84. I start with a count of the total number of crimes in different categories, (*e.g.*, motor vehicle theft, prostitution, vandalism) committed within the Cabell Huntington Community, based on reports from law-enforcement agencies (LEAs) covering the Community. Counts of incidents come from the National Incident-Based Reporting System (NIBRS) maintained by the FBI. NIBRS data are a standard source used to measure criminal offenses by criminal category for LEAs that report into the NIBRS. However, not all LEAs report their data to the NIBRS.¹⁵⁴

85. Starting with 2011, NIBRS does not include crime counts for some LEAs. Where data are missing in the NIBRS, my staff contacted the LEA directly to obtain crime reports. Where data remain unavailable, I exclude these LEAs from the count for that year, in effect, conservatively, attributing no crimes to that LEA in that year. LEAs with at least one year of data from 2006-2018 are: The City of Huntington, Cabell County Sheriff's Office, Marshall University, Barboursville Village, The Town of Milton, the Cabell State Police, the State Fire Marshall, and the Cabell County Department of Natural Resources.¹⁵⁵

¹⁵³ The City of Solutions, Huntington WV, p. 76.

¹⁵⁴ The Bureau of Justice Statistics reported that, "In 2012 NIBRS-contributing agencies served approximately 30 percent of the U.S. population and accounted for 28 percent of all crime reported to the UCR [Uniform Crime Reporting] Program." See Bureau of Justice Statistics, "Data Collection: National Incident-Based Reporting System (NIBRS)" (<https://www.bjs.gov/index.cfm?ty=dcdetail&iid=301>). Some of the larger LEAs in Cabell County did not report crimes to NIBRS during 2011-2018, including the Huntington Police Department and the Cabell County Sheriff.

¹⁵⁵ Specifics on data available for each of the LEAs are contained in Appendix C. Alternate sources are also explained there.

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86. Crime counts include drug-related crimes (possession, selling, or distribution of illegal drugs), where the primary criminal activity relates to drugs, and other crimes (arson, battery, vandalism) that occurred due to drugs. For drug-related crimes, I estimate the share of these that are opioid related based on the share of all drug seizures in West Virginia that involved opioids.¹⁵⁶ I then adjust these crime counts by the share of OUD in Cabell County due directly and indirectly to prescription opioids applying the last row of Table 4. For other crimes (*e.g.*, battery), I use findings from research studies to estimate the share of these crimes that are attributable to drugs.¹⁵⁷ I then apply the same adjustment for drug-related crimes to find the number of other crimes attributable to prescription opioids. See Section IV.1 of Appendix C for details on crime counts.

Valuing the Cost of Crimes

87. A commonly used framework in the economic literature on crime classifies costs into direct, indirect, and intangible costs.¹⁵⁸ Direct costs include medical costs, the costs of private crime deterrents (alarms, security), public expenditures on police, court costs associated with investigating and prosecuting criminal activity, and the value of property lost due to criminal activity. Indirect costs of crime include the productivity loss for victims of violent crime and the loss in productivity due to addiction and incarceration for the perpetrator. Finally, intangible costs consist of pain, suffering, and psychological consequences borne by crime victims and the public.

88. Direct costs of crime are often estimated by combining several sources of data, including government data on criminal justice system costs, surveys on medical expenses, and property

¹⁵⁶ I use West Virginia data reported to the National Forensic Laboratory Information System (NFLIS) on the number of drug crimes involving opioids.

¹⁵⁷ The share of criminal activity due to drugs comes from this report: U.S. Department of Justice, National Drug Intelligence Center, “The Economic Impact of Illicit Drug Use on American Society,” 2011 (<https://www.justice.gov/archive/ndic/pubs44/44731/44731p.pdf>).

¹⁵⁸ Two literature reviews are: N. Wickramasekera, *et al.*, “Cost of Crime: A Systematic Review,” *Journal of Criminal Justice*, 43(3), 2015, pp. 218-228 and K.E. McCollister, M.T. French and H. Fang, “The Cost of Crime to Society: New Crime-Specific Estimates for Policy and Program Evaluation,” *Drug and Alcohol Dependence*, 108(1-2), 2010, pp. 98-109.

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loss associated with crime.¹⁵⁹ The main component of the indirect costs of crime is productivity loss by both the victims and the perpetrators. Crimes that result in injury or hospitalization lead to a reduction in victim productivity. The opportunity cost to criminals of engaging in productive activities is also included in the indirect cost of crime.¹⁶⁰ Finally, intangible costs include the emotional and psychological consequences of criminal activity imposed on victims and the public. The “jury-compensation approach” uses monetary amounts awarded by juries in injury cases, net of medical costs and lost wages, to estimate intangible costs to victims.¹⁶¹ A second method for estimating intangible costs, the contingent valuation approach, uses surveys to estimate respondents’ willingness-to-pay for reductions in hypothetical risk of pain, suffering or various types of crimes. See Appendix C, Section IV.2 for further descriptions regarding crime valuation.

89. Another perspective on costs comes from considering the value of public services police could have provided had they not been diverted into opioid-related crimes. The surge in opioid-related crime consumed much of the Huntington Police Department officers’ time and resources. According to Captain Dial, “the detectives have had a hard time handling the workload ...”¹⁶² Diversion of police resources to opioid-related crime means less resources available for other law enforcement activities, for example, increasing wait times after a call and less police time available for investigation. As Chief Ciccarelli explained in *The Herald Dispatch*, “We maintained our staffing where it’s at to ensure we can make these [overdose] calls, but to do that, other areas have had to suffer.” The suffering referred to by the Chief is experienced by the residents of the Cabell Huntington Community. Cabell County Sheriff Charles Zerkle confirms

¹⁵⁹ See D.A. Anderson, “The Cost of Crime,” *Foundations and Trends® in Microeconomics*, July 3, 2011, pp. 209-265, chapter 4, for a discussion and a representative example of the data-aggregation methods used in crime costing studies.

¹⁶⁰ These costs are often calculated by multiplying the minimum wage by the amount of person-years spent by criminals in incarceration. This assumes incarcerated individuals would work full time at a low-paying job if not incarcerated. This measure is likely an underestimation of this form of crime cost because it omits the opportunity cost of crime that does not result in incarceration. See McCollister *op. cit.*

¹⁶¹ This methodology was developed in M.A. Cohen, “Pain, Suffering, And Jury Awards: A Study of the Cost of Crime to Victims,” *Law & Society Review*, 22(3), 1988, pp. 537-555.

¹⁶² J. Qualls, and C. Hessler, *op. cit.*

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his office's inability to keep up with the rash of opioid-related crime: "... We were overwhelmed and we lacked resources, and we continued to lack resources to do our job."¹⁶³

90. Sheriff Zerkle was explicit about the cost of devoting police resources to opioid-related problems in schools. In his deposition he states: "... I have five [deputies] that are assigned to schools. They're school resource officers. I took some flack over that a little bit, that I pulled that many people. I have 12 percent of my workforce in the schools. But what's happened during this timeline, our children, they've lost their families, they've lost their mothers and fathers. Now the grandparents are trying to raise them. And disruption in the school and stuff, I thought it was a good investment in our kids and our future to put those five deputies in the schools."¹⁶⁴

91. Table 8 presents dollar estimates of the costs of crime across all types of offenses for the Cabell Huntington Community. These figures include direct, indirect, and intangible costs as described above. In total, I estimate that crimes due to sales and distribution of prescription opioid from 2006-2018 led to excess costs of over \$77.4 million in the Community.

¹⁶³ Deposition of Charles Zerkle, in this matter, June 17, 2020, (hereafter Zerkle Deposition), p. 190.

¹⁶⁴ Zerkle Deposition, pp. 71-72.

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Table 8
Crime and Valuation of Crime Attributed to
Prescription Opioid Sales and Distribution
Cabell Huntington Community, 2006-2018

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
[1] Crime events attributable to prescription opioids	482.1	447.4	543.4	842.9	657.6	545.6	734.1	700.2	977.8	860.7	917.7	749.8	730.3	9,189.8
[2] Costs for crimes attributable to prescription opioids (\$millions)	\$3.7	\$3.7	\$4.8	\$7.0	\$5.3	\$4.4	\$5.7	\$5.7	\$7.3	\$6.5	\$8.3	\$8.1	\$7.0	\$77.4

Sources: Appendix C, Tables C.IV.1 - C.IV.4.

E. Prescription Opioid-Related Crime and Property Values

Overview

92. One pernicious and impossible-to-miss harm from the opioid epidemic is neighborhood blight, the degradation of neighborhoods contaminated by drug sellers, drug users, and crime. The association between crime, empty homes, and neighborhood decline is widely documented.¹⁶⁵ Homes and neighborhoods in the Cabell Huntington Community have been severely adversely affected by the opioid epidemic, with hundreds of homes demolished due to abandonment, crime, and uninhabitability. From a December 2019 report in the *West Virginia Metro News*:

“[City of Huntington Demolitions Specialist Crystal] Perry said Huntington Mayor Steve Williams and others began looking at the abandoned house issue a few years ago with the rise of the opioid epidemic. She said there were originally about 500 structures identified. The list of remaining structures is now down to about 130.”¹⁶⁶

93. For many households in Cabell, a home is their primary form of wealth. The median net wealth of American households, as measured by net worth, was \$94,670 in 2016, with 34.5% of

¹⁶⁵ See, for example, I.G. Ellen, J. Laco, and C.A. Sharygin, “Do Foreclosures Cause Crime?” *Journal of Urban Economics*, 74, 2013, pp. 59-70; L. Cui, and R. Walsh, “Foreclosure, Vacancy and Crime,” *Journal of Urban Economics*, 87, 2015, pp. 72-84; and J. J. Roth, “Empty Homes and Acquisitive Crime: Does Vacancy Type Matter?” *American Journal of Criminal Justice*, 44(5), 2019, pp. 770-787.

¹⁶⁶ J. Jenkins. “Huntington House Demo Number Climbs to 100.” *WV MetroNews*, December 23, 2019 (wvmetronews.com/2019/12/23/huntington-house-demo-number-climbs-to-100/).

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that composed of home equity.¹⁶⁷ Home ownership is an especially important financial asset for individuals at the lower end of the income distribution.¹⁶⁸ Crime-caused loss in home value can impose substantial harm on all residents of affected communities. A safe, comfortable home is, of course, more than a holding in a financial portfolio.

94. The residential housing market in Cabell County shows signs of being depressed due to the opioid epidemic. The addition of new housing stock in Cabell County declined dramatically starting in 2013, going against state and national trends.¹⁶⁹ The average listing price of Cabell County housing declined significantly from 2017-2019.¹⁷⁰ During 2006-2018, West Virginia's house pricing index increased steadily whereas Cabell County's remained relatively flat.¹⁷¹ The population of Cabell County has fallen since 2013.¹⁷² A recent news article, however, reports a rebound in the Cabell housing market.¹⁷³

95. The opioid epidemic degrades neighborhoods along many dimensions. Risk of crime, loss of safe public space, loss of connection with neighbors and other harms interfere with residents' ability to appreciate where they live. Degradation lowers home property values and

¹⁶⁷ J. Eggleston and R. Munk, "Net Worth of Households: 2016," *US Census Bureau Report P70BR-166*, 2019.

¹⁶⁸ "Houses are *the* asset of the bottom 90%, making residential real estate the most egalitarian asset ... The bottom 90% hold about half of all housing wealth ..." in M. Kuhn, M. Schularick, and U. Steins, "Income and Wealth Inequality in America, 1949-2016," Opportunity & Inclusive Growth Institute, Federal Reserve Bank of Minneapolis, Institute Working Paper No. 9, June 2018, p. 35.

¹⁶⁹ U.S. Census Bureau, New Private Housing Structures Authorized by Building Permits for Cabell County, WV [BPPRIV054011], West Virginia [WVBPPRIV], and nationwide [PEMIT] retrieved from FRED, Federal Reserve Bank of St. Louis (<https://fred.stlouisfed.org/series/BPPRIV054011>, April 21, 2020). Graph available here: <https://fred.stlouisfed.org/graph/?g=qMe1>).

¹⁷⁰ Realtor.com, Housing Inventory: Average Listing Price in Cabell County, WV [AVELISPRI54011], retrieved from FRED, Federal Reserve Bank of St. Louis (<https://fred.stlouisfed.org/series/AVELISPRI54011>, April 21, 2020).

¹⁷¹ U.S. Federal Housing Finance Agency, All-Transactions House Price Index for Cabell County, WV [ATNHPIUS54011A], (<https://fred.stlouisfed.org/series/ATNHPIUS54011A>, June 24, 2020) and West Virginia [WVSTHPI], retrieved from FRED, Federal Reserve Bank of St. Louis, (<https://fred.stlouisfed.org/series/WVSTHPI>, May 26, 2020). Realtor.com, Housing Inventory: Average Listing Price in Cabell County, WV [AVELISPRI54011], retrieved from FRED, Federal Reserve Bank of St. Louis (<https://fred.stlouisfed.org/series/AVELISPRI54011>, July 2, 2020).

¹⁷² U.S. Census Bureau, Resident Population in Cabell County, WV [WVCABE1POP], retrieved from FRED, Federal Reserve Bank of St. Louis (<https://fred.stlouisfed.org/series/WVCABE1POP>, April 21, 2020).

¹⁷³ "I. Johnson: Progress is Happening in Cabell County, and the Assessor's Office," *The Herald Dispatch*, March 20, 2020 (https://www.herald-dispatch.com/news/irv-johnson-progress-is-happening-in-cabell-county-and-the-assessors-office/article_632ab6e0-4fbb-5cd5-9361-a3ed46d2fab9.html).

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lowers residents' valuation of parks, public transportation, schools, and other local public services.¹⁷⁴

96. In this section, I address the question, "How much higher would property values in the Cabell Huntington Community be absent the crimes due to prescription opioids?" The economic model I apply to answer this question can be depicted as follows:

Prescription Opioids → Elevated Crime Rates → Decrease in Property Values

97. The first causal link, between prescriptions and crime, has already been covered in Section III.D. Overall, I calculate that prescription opioids were responsible for 7.2% of total crimes in the Cabell Huntington Community over the period 2006 to 2018.¹⁷⁵ The second causal arrow, between crime and property values is covered in Section IV.3 of Appendix C. With the magnitude of this second section quantified, I can quantify the decrease in property values that has resulted from prescription opioid-related crimes. This property value lost due to crime associated with the sales and distribution of prescription opioids is an economic harm caused by prescription opioids.

98. The value of residential property in Cabell County in 2019 was \$5.13 billion. Eliminating the crime associated with the sales and distribution of prescription opioids would increase this value by 1.8%, or \$92.3 million. See Section IV.3 of Appendix C for details of these calculations.

¹⁷⁴ Lower crime rates "unlock" the value of public parks in Chicago, New York and Philadelphia according to a study by Albouy and colleagues. Parks have a positive effect on local housing prices in low-crime areas but this positive effect turns negative in higher crime areas. D. Albouy, P. Christensen, I. Sarmiento-Barbieri, "Unlocking Amenities: Estimating Public-Good Complementarity," National Bureau of Economic Research, Working Paper 25107, revised July 2019. The relation between the amenity value of public parks and crime was also studied by Troy and Grove in Baltimore with the same result. High crime turns a public good into a public bad. A. Troy. and J.M. Grove, "Property Values, Parks, and Crime: A hedonic analysis in Baltimore, MD," *Landscape and Urban Planning*, 87(3), 2008, pp. 233-245.

¹⁷⁵ The total number of crimes in Cabell County during 2006-2018 is 128,376 (see Appendix C for source). Table 8 of my Report shows that 9,189 crimes were attributable to prescription opioids. The ratio of these numbers yields this estimate.

Confidential**F. Child Maltreatment**Overview

99. Substance abuse, including opioid abuse, is a major cause of child maltreatment.¹⁷⁶ According to the U.S. Department of Health and Human Services, in fiscal year 2018, approximately 678,000 children were subject to abuse and neglect in the U.S. This amounts to about 9.2 victims per 1,000 children nationwide.¹⁷⁷ In West Virginia, the victimization rate in 2018 was 19.1 per 1,000 children.¹⁷⁸ Drug abuse in a household is a major risk factor associated with child maltreatment. Nationally, 30.7% of 2018 victims lived in households with caregivers with drug abuse risk factors.¹⁷⁹ The analogous figure in West Virginia is 57.1%¹⁸⁰

100. Like other harms, my valuation of the economic harm from child maltreatment is the product of the number of victims where prescription opioids were involved multiplied by the costs associated with this maltreatment. Although maltreated children face a host of negative consequences, for the purposes of my valuation, due to data limitations, I focus on lost earnings in adulthood due to lower educational attainment, plus special educational services provided to maltreated children.

101. In an aggressive effort to combat harms to children from the opioid epidemic, Cabell Huntington Community leaders have created programs for vulnerable women and children. One such effort is Project Hope. Initially administered by the Huntington City Mission, Project Hope expanded the number of transitional housing units available to women in recovery and their children.¹⁸¹ These homes come with 24-hour care and clinical services including group therapy

¹⁷⁶ See Children's Bureau, Office of the Administration for Children and Families, U.S. Department of Health & Human Services (HHS), "Child Maltreatment 2018," 2019, (<https://www.acf.hhs.gov/sites/default/files/cb/cm2018.pdf>); O. Mowbray, *et al.*, "Longitudinal Trends in Substance Use and Mental Health Service Needs in Child Welfare," *Children and Youth Services Review*, 73, February 2017, pp. 1-8.

¹⁷⁷ HHS (2019), *op. cit.*, p. 21.

¹⁷⁸ HHS (2019), *op. cit.*, p. 30.

¹⁷⁹ Drug abuse is defined as "...the compulsive use of drugs that is not of a temporary nature." HHS (2019), *op. cit.*, p. 21, 43.

¹⁸⁰ HHS (2019), *op. cit.*, p. 43.

¹⁸¹ The City of Solutions, Huntington WV, p. 38.

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and MOUD. Moreover, Project Hope also provides fitness classes, GED training, peer coaching, and job training events.

102. Healthy Connections is another such effort.¹⁸² This program aims to reintegrate recovering participants into society, via the use of navigators – case workers with small caseloads who specialize in issues faced by women and children suffering from the consequences of substance abuse. Healthy Connections navigators and coaches start work with participants as early as possible, design specialized recovery plans tailored for the unique circumstances faced by each participant, and provide guidance through the full re-entry process. In addition, navigators integrate other members of the family, particularly grandparents and fathers of the children, in order to better care for these at-risk children.

Count of Victims of Maltreatment

103. I estimate the number of children maltreated due to the sales and distribution of prescription opioids in the Cabell Huntington Community in five steps. First, I obtain three data series from the HHS's Administration for Children and Families (ACF): the number of maltreatment victims that are first-time, unique, and unique with a drug abuse risk factor in West Virginia.¹⁸³ Second, I take the ratio of first-time to unique victims, and apply that to the number of unique maltreatment victims with a drug abuse risk factor, in order to estimate the number of first-time victims with a drug abuse risk factor. Third, I adjust these state-wide counts by the number of children in Cabell County to obtain County-level numbers. Fourth, to estimate the share of drug abuse-related maltreatment victims attributable to opioids, I multiply the number of drug abuse-related maltreatment victims by the share of drug seizures that involved opioids, as I did in section III.D. above. Finally, I multiply this count by the opioid morbidity attributable to

¹⁸² The City of Solutions, Huntington WV, p. 45.

¹⁸³ Administration for Children and Families (<https://www.acf.hhs.gov>) is a division in the department of Health and Human Services which collects detailed annual information from states on child maltreatment and produces yearly reports on state level incidence of maltreatment, overall and broken out by category, as well as information on characteristics of victims, number of fatalities, services to prevent maltreatment among other metrics. These data are an important source of information for reports to congress and federal government activities. The statistics on child maltreatment are derived from data collected by child protective agencies through the National Child Abuse and Neglect Data system (NCANDS). See Appendix C for the estimation of these counts for 2006-2009, 2013 and 2015 when data is unavailable. Appendix C also has information on the use of first-time maltreat victim counts to avoid double counting over the period.

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prescription opioids from the bottom row of Table 4.¹⁸⁴ This gives me an estimate of the number of maltreated children in West Virginia due to prescription opioids.

Valuing the Cost of Maltreatment

104. The research literature establishes that child maltreatment (abuse or neglect) devastates a child, lowering educational attainment;¹⁸⁵ reducing cognitive development;¹⁸⁶ increasing the need for special education services;¹⁸⁷ lowering employment and earnings;¹⁸⁸ and causing higher rates of preventable deaths,¹⁸⁹ obesity,¹⁹⁰ depression,¹⁹¹ substance abuse,¹⁹² and PTSD.¹⁹³

¹⁸⁴ Note that for 2006, I use unique maltreatment victim counts, and from 2007-2018, I use first-time victims.

¹⁸⁵ R. Gilbert, *et al.*, “Burden and consequences of child maltreatment in high-income countries,” *The Lancet*, 373, 2009, pp. 68-81; J. Currie and C.S. Widom, “Long-Term Consequences of Child Abuse and Neglect on Adult Economic Well-Being,” *Child Maltreatment*, 15(2), 2010, pp. 111-120; J.P. Mersky and J. Topitzes, “Comparing Early Adult Outcomes of Maltreated And Non-Maltreated Children: A Prospective Longitudinal Investigation,” *Children and Youth Services Review*, 32(8), 2010, pp. 1086-1096; J.J. Doyle and A. Aizer, “Economics of Child Protection: Maltreatment, Foster Care, and Intimate Partner Violence,” *Annual Review of Economics*, 10, 2018, pp. 87-108; A. Bald, E. Chyn, J.S. Hastings, and M. Machelett, “The Causal Impact of Removing Children from Abusive and Neglectful Homes,” NBER Working Paper 25419, January 2019.

¹⁸⁶ K.L. Hildyard and D.A. Wolfe, “Child Neglect: Developmental Issues and Outcomes,” *Child Abuse & Neglect*, 26, 2002, pp. 679-695; C.M. Perez and C.S. Widom, “Childhood Victimization and Long-Term Intellectual and Academic Outcomes,” *Child Abuse & Neglect*, 18(8), 1994, pp. 617-633; J. Currie & C.S. Widom, *op. cit.*

¹⁸⁷ M. Jonson-Reid, *et al.*, “A Prospective Analysis of the Relationship Between Reported Child Maltreatment and Special Education Eligibility Among Poor Children,” *Child Maltreatment*, 9(4), 2004, pp. 382-394; R.J. Gelles and S. Perlman, “Estimated Annual Cost of Child Abuse and Neglect,” Prevent Child Abuse America; April 2012 (https://preventchildabuse.org/wp-content/uploads/2016/02/PCA_COM2012-1.pdf); R. Gilbert, *et al.*, *op. cit.*

¹⁸⁸ R.J. Gelles & S. Perlman, *op. cit.*; R. Gilbert, *et al.*, *op. cit.*; J. Currie & C.S. Wido, *op. cit.*; J.P. Mersky and J. Topitzes, *op. cit.*

¹⁸⁹ A. Hjern, B. Vinnerljung, and F. Lindblad, “Avoidable Mortality Among Child Welfare Recipients and Intercountry Adoptees: a National Cohort Study,” *Journal of Epidemiology & Community Health*, 58(5), 2004, pp. 412-417.

¹⁹⁰ L.M. Berger and J. Waldfogel, “Economic Determinants and Consequences of Child Maltreatment,” OECD Social, Employment and Migration, Working Paper No. 111, April 2011, OECD Publishing, Paris (<http://dx.doi.org/10.1787/5kgf09zj7h9t-en>); R. Gilbert, *et al.*, *op. cit.*

¹⁹¹ L.M. Berger and J. Waldfogel, *op. cit.*; R. Gilbert, *et al.*, *op. cit.*; A. Bald, E. Chyn, J.S. Hastings, and M. Machelett, *op. cit.*; J.P. Mersky and J. Topitzes, *op. cit.*; C.S. Widom, K. DuMont, and S.J. Czaja, “A Prospective Investigation of Major Depressive Disorder and Comorbidity in Abused and Neglected Children Grown Up,” *Archives of General Psychiatry*, 64(1), 2007, pp. 49-56.

¹⁹² L.M. Berger and J. Waldfogel, *op. cit.*; R. Gilbert, *et al.*, *op. cit.*; J.P. Mersky and J. Topitzes, *op. cit.*; C.S. Widom, K. DuMont, and S.J. Czaja, *op. cit.*

¹⁹³ L.M. Berger and J. Waldfogel, *op. cit.*; R. Gilbert, *et al.*, *op. cit.*; C.S. Widom, K. DuMont, and S.J. Czaja, *op. cit.*; C.S. Widom, “Posttraumatic Stress Disorder in Abused and Neglected Children Grown Up,” *American Journal of Psychiatry*, 156(8), 1999, pp. 1223-1229.

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Furthermore, maltreatment elevates rates of juvenile delinquency¹⁹⁴ and crime.¹⁹⁵ These negative effects of maltreatment are costly. For reasons of data availability, I confine my estimates to harms from two categories: lost earnings and special education costs. For each of these two outcomes, I determine the estimated incremental effect of maltreatment on the outcome.¹⁹⁶

105. Table 9 reports the dollar estimates of the cost of child maltreatment in Cabell County. I estimate that the social costs of cases of maltreatment attributable to opioid prescription sales and distribution between 2006-2018 in Cabell County was over \$57.9 million.

Table 9
Child Maltreatment Victims and Costs Attributed to
Prescription Opioid Sales and Distribution
Cabell County, 2006-2018

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Maltreatment victims attributable to prescription opioids	3	2	2	4	4	4	5	7	6	6	55	53	51	201
Costs for child maltreatment attributable to prescription opioids (\$ millions)	\$0.81	\$0.50	\$0.68	\$1.05	\$1.03	\$1.21	\$1.43	\$1.91	\$1.76	\$1.87	\$15.78	\$15.19	\$14.71	\$57.9

Sources: Appendix C, Tables C.V.1 and C.V.2.

¹⁹⁴ C.S. Widom, “The Cycle of Violence,” *Science*, 244(4901), 1989, pp. 160-166; R.J. Gelles & S. Perlman, *op. cit.*; R. Gilbert, *et al.*, *op. cit.*; M.G. Maxfield and C.S. Widom, “The Cycle of Violence: Revisited 6 Years Later,” *Archives of Pediatrics & Adolescent Medicine*, 150(4), 1996, pp. 390-395; C.S. Widom and M.G. Maxfield, “An Update on the ‘Cycle of Violence.’ Research in Brief,” U.S. Department of Justice, February 2001 (<https://files.eric.ed.gov/fulltext/ED451313.pdf>).

¹⁹⁵ J. Currie and E. Tekin, “Does child abuse cause crime?” NBER Working Paper 12171, April 2006; Doyle and Aizer, *op. cit.*; R.J. Gelles & S. Perlman, *op. cit.*; R. Gilbert, *et al.*, *op. cit.*; Widom, *op. cit.*; J. Currie and E. Tekin, “Understanding the cycle: Childhood Maltreatment and Future Crime,” *Journal of Human Resources*, 47(2), 2012, pp. 509-549; J.P. Mersky and J. Topitzes, *op. cit.*; M.G. Maxfield and C.S. Widom, *op. cit.*; C.S. Widom and M.G. Maxfield, *op. cit.*

¹⁹⁶ See Appendix C.

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IV. The Economic Costs Imposed by Sales and Distribution of Prescription Opioid Products are of Sufficient Magnitude to Constitute a Public Nuisance to the Cabell Huntington Community

A. Summary of Costs Imposed

106. Table 1, repeated here from the Introduction, summarizes the costs associated with categories of harms studied above from 2006-2018. Over these thirteen years, the costs attributable to the sales and distribution of prescription opioids in the Cabell Huntington Community totaled over \$4.17 billion dollars, implying a cost of over \$43 thousand per Cabell Huntington Community resident.

107. I regard my estimates of the costs imposed by the sales and distribution of prescription opioids to be conservative for a number of reasons. First, due to limitations on data availability, my calculations do not include the years 2019 and 2020. If I use the cost for 2018 as an estimate of the costs for each of 2019 and 2020, my estimates increase by \$1.7 billion. Further, my calculations for each of the harms I address are based upon a series of conservative assumptions, some of which are noted in Table 10.

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Table 1
Monetary Value of the Net Costs Attributed to the
Sales and Distribution of Prescription Opioids
in the Cabell Huntington Community
2006-2018

Harms Due to Sales & Distribution of Prescription Opioids	Valuation (\$millions)
Excess deaths	\$3,437.8
Excess morbidity	\$501.3
Excess neonatal abstinence syndrome	\$2.6
Excess crimes	\$77.4
Excess property value loss	\$92.3
Excess child maltreatment	\$57.9
Total	\$4,169.2

Sources: Tables 3, 5, 7, 8, 9, and Section III.E of this Report.

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Table 10
Conservative Assumptions Applied in Estimating Costs in this Report

Harm	Conservative Assumptions
Mortality	<ul style="list-style-type: none"> • Does not include damage to community fabric, financial dependents of those who died, compassion fatigue among first responders • VSL valuation is U-shaped, implying higher valuation for working-age adults. Opioid deaths are largely working-age adults • Does not include portion of Huntington in Wayne County
Morbidity	<ul style="list-style-type: none"> • Only accounts for OUD treatment related health care expenditures paid by third parties • Undercounts costs of comorbidities such as Hepatitis, HIV, and infectious endocarditis • Does not include community efforts and centers specifically launched to combat the effects of OUD • Does not quantify the net negative effects on labor-force participation and productivity • Does not include portion of Huntington in Wayne County
NAS	<ul style="list-style-type: none"> • Excludes community efforts to treat NAS cases, such as Lily's Place and Project Hope • Does not include the adulthood costs from lower educational outcomes due to NAS, such as upward mobility, income, and others • Does not include portion of Huntington in Wayne County • Does not include case counts beyond 2015
Crime	<ul style="list-style-type: none"> • Crime counts of criminal activity are lower than actual due to LEAs not reporting • Excludes stress to first responders and others in the community from increased criminal activity
Property Values	<ul style="list-style-type: none"> • Costs were assessed on residential property only • Does not include portion of Huntington in Wayne County
Maltreatment	<ul style="list-style-type: none"> • Excludes valuation of other maltreatment consequences: juvenile delinquency, preventable death, lowered mental health, increase in substance abuse rates, and PTSD • Does not include portion of Huntington in Wayne County

Confidential**B. Costs Imposed Were of Sufficient Magnitude to Constitute a Public Nuisance**

108. Since from the year I have been asked to monetize harms, 2006, and likely earlier, the Community has been awash in prescription opioids. Shipment data produced in related litigation shows that between 2006 and 2014, manufacturers and distributors shipped hydrocodone and oxycodone opioids to the State of West Virginia sufficient to give 611 pills to every man, woman and child in the state.¹⁹⁷ The situation in Cabell County was even more dire. Dr. McCann, in his report, quantifies the volume of morphine milligram equivalents (MMEs) shipped into Cabell County.¹⁹⁸ He reports that over 3.2 billion MMEs or approximately 128 million dosage units were shipped into Cabell County from 2006-2014, equivalent to over 1,300 doses for each Cabell County resident.¹⁹⁹

109. County and city officials attest to the ongoing public nuisance in the Community caused by the opioid epidemic. For example, Beth Thompson, Administrator for the Cabell County Commission, in her deposition,²⁰⁰ stated her view:

“Q. You testified earlier that you knew – why do you believe it's a public nuisance now?

A. Because of the health and safety of our community has been compromised. ...

Q. Are there any indicators to you that would signify that the nuisance is over?

A. Maybe when we don't have to have Lily's Place where people sit and rock babies that won't quit crying because they're, you know, addicted to drugs when they're born. Maybe when I can look out my window at work and not see somebody having an overdose on the lawn of the courthouse. Or going by our vehicles and stabbing each other and we have to have security officers walking us to the cars in the evenings and to the courthouse in the mornings. Stealing people's -- kids' bicycles out of their yards. You know, maybe when there's an end to all that, maybe it's over.”

110. Fire Chief Rader explained some of the community-wide and ongoing harms:

“...you have a whole generation of grandparents raising their grandchildren because adults are behind bars or have died opioid-related deaths... You have people incarcerated who...may have a felony hanging over their head, which makes it very difficult for them to find employment....You have first responders that will probably never be able to recover

¹⁹⁷ Complaint, ¶ 4.

¹⁹⁸ Expert Report of Craig J. McCann, Ph.D., CFA, in this matter, August 3, 2020, Table 15, p. 79.

¹⁹⁹ Based on the 2018 Cabell Huntington Community population of 96,619.

²⁰⁰ Deposition of Beth Thompson, in this matter, July 7, 2020, pp. 248-249 (counsel objections omitted).

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from this....How do you support the children that watch their parents overdose? They're being put into the foster care system. "²⁰¹

Later, when asked to describe the opioid epidemic:

Q. And Chief Rader, if you could describe the opioid epidemic in Huntington with one word, what would that be?

A. It's horrific.²⁰²

107. In 2015, the Mayor of Huntington, Steve Williams, conveyed the magnitude of the harms: "The epidemic of addiction is now so pervasive that our standard of living, our way of life and our children's future is at stake."²⁰³ In deposition, when asked if prescribing opioids is a public nuisance, Mayor Williams responded "If it leads – yes, if it leads to public health problems and public safety problems, as it has."²⁰⁴ The Mayor gave direct and unambiguous responses to questions related to prescription opioids as a public nuisance:

Q. Does the opioid epidemic interfere with the public health in the City of Huntington?

A. Yes.

Q. Does the opioid epidemic interfere with the public safety in the City of Huntington?

A. Yes.

Q. Mayor, based on your experience living in the City of Huntington and serving as the mayor of the City of Huntington, do you believe there presently exists a hazard to the public health and safety arising out of a prescription opioid epidemic?

A. Yes.²⁰⁵

111. After review of the evidence on the harms caused by the sales and distribution of prescription opioids to the Cabell Huntington Community, including the testimony of local officials, I am aware that the dry economic language of "costs and benefits" is inadequate to convey the full magnitude of the destruction wrought by prescription opioids on the Community. The economic concept of "costs" is useful to quantify the harms with a common denominator of

²⁰¹ Rader Deposition, pp. 197-199

²⁰² Rader Deposition, p. 265.

²⁰³ Mayor Steve Williams, City of Huntington, Letter to the residents of Huntington and the Tri-State Region, in: City of Huntington, Mayor's Office of Drug Control Policy, "2017 Strategic Plan," May 2017, p. ii.

²⁰⁴ Williams Deposition, p. 50.

²⁰⁵ *Ibid.*, p. 300.

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dollars, enabling an economist to add them up using one metric. But actual harms take place in real-life terms, and in many forms: babies born addicted to opioids facing a lifetime of disability and disadvantage, the risk of opioid-related crimes degrading home values because of the lower quality of life caused by crime, death and disease of sufficient magnitude to touch nearly every family in the community.

112. Ongoing harms of more than \$4 billion imposed on a small community over 13 years establish that the harms from prescription opioids are of sufficient magnitude to constitute a public nuisance. The population of the Cabell Huntington Community was 96,619 in 2018.²⁰⁶ The costs reported in Table 1 amounted, over the period covered in my Report, to approximately \$43 thousand per person in the Community. These costs are net of any economic benefits from workforce participation.

113. The position of the Cabell Huntington Community relative to the national opioid crisis yields another perspective. As a rule of thumb (see Figures 2 and 5 above), opioid-related harms in the Cabell Huntington Community are an *order of magnitude greater* than nationwide. Looked at another way, by some metrics, West Virginia has been the state hardest hit by prescription opioids, and within West Virginia, Cabell County has been the 3rd hardest-hit county.²⁰⁷ Cabell has been referred to as “ground zero” of the opioid crisis.²⁰⁸ If the sales and distribution of prescription opioids qualify as a public nuisance anywhere, they qualify in the Cabell Huntington Community.

114. Based on the cost analysis in Section III, I conclude that the harms to the Community caused by the sales and distribution of prescription opioids are of sufficient magnitude to constitute a public nuisance. My economic analysis establishes that the sales and distribution of prescription opioids has interfered with public health, safety, peace, and comfort of residents of the Cabell Huntington Community, with economically large, continuing, and long-lasting effects.

²⁰⁶ U.S. Census, County Population by Characteristics, 2010-2019. Estimate for 2018 (<https://www.census.gov/data/tables/time-series/demo/popest/2010s-counties-detail.html>).

²⁰⁷ See, for example, the NAS rate in Cabell County, Figure 7, the number of opioid shipments compared to West Virginia and nationwide.

²⁰⁸ C. Babcock, N. Rockich-Winston, and C. Booth, “Bringing Naloxone to Ground Zero: Huntington, West Virginia,” *Journal of the American Pharmacists Association*, 57.2, 2017, pp. S9-S10.

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My Report quantifies in dollar terms the negative effects of death, disease, children born addicted, crime, loss of property values, and child maltreatment.

Pursuant to 28 U.S.C. S 1746, I declare under penalty of perjury that the foregoing is true and correct.



Thomas McGuire

August 3, 2020

Appendix A

May 4, 2020

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Education:

Year	Degree	Institution	Field
1971	B.A. Summa Cum Laude	Princeton University	Economics
1976	Ph.D.	Yale University	Economics

Academic Appointments:

Year	Academic Title	Institution
2001-present	Professor	Harvard Medical School
1987-2001	Professor	Boston University
1981-1996	Visiting Professor	Brandeis University
1983-1987	Associate Professor	Boston University
1980-81	Postdoctoral Fellow	Yale University
1976-1983	Assistant Professor	Boston University

Other Professional Positions:

Year	Position/Title	Institution
2012-present	Research Associate	National Bureau of Economic Research

Major Committee and Association Memberships:

Year	Position/Title	Institution
2003-2007	Member	NIH/ National Center for Research Resources, Council
1994-1998	Member	National Institute of Mental Health Services Research Review Committee
1980-84	Member	National Institute of Mental Health Epidemiologic and Services Research Review Committee
2000-present	Member	National Academies of Science, Education and Medicine/Institute of Medicine
2003-2009	Board of Directors	International Health Economics Association

Major Editorial Positions:

2001-2011	Editor	<i>Journal of Health Economics</i>
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Awards and Honors:

Year	Name of Award
2018	Victor Fuchs Award from the American Society of Health Economics for Lifetime Contributions to the Field of Health Economics
2016	Article of the Year, <i>International Journal of the Economics of Business</i>
2014	National Institute for Health Care Management Paper of the Year
2008	National Institute for Health Care Management Paper of the Year
2008	AcademyHealth Article of the Year Award
2008	Everett Mendelsohn Excellence in Mentoring Award
2006	Emily Mumford Medal for Distinguished Contributions to Social Science In Medicine
1997	Kenneth J. Arrow Award for Best Paper published in Health Economics
1994-1996	Investigator Award in Health Policy, Robert Wood Johnson Foundation
1991	Carl A. Taube Award for outstanding contributions to mental health services research, American Public Health Association
1989-1994, 1994-1999	Research Scientist Award, National Institute for Mental Health
1983	Elizur Wright Award for an outstanding contribution to the literature on risk and insurance (<i>Financing Psychotherapy</i>), American Risk and Insurance Association
1979	Abt Prize for Research on National Policy Issues

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Albert Ma and Thomas G. McGuire (guest editors) "The Industrial Organization of Health Care, III," *Journal of Economics & Management Strategy*, 8(3), Fall 1999.

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Thomas McGuire: Litigation Experience, 2016-Present

In re: Cipro Cases I & II, In the Supreme Court of California, Case No. S198616

Allegations: The Bayer-Barr settlement of patent litigation related to the drug Cipro included anticompetitive reverse payments. I testified about the regulatory framework established by the Hatch Waxman Act and the economics of drug pricing and distribution.

Assignment: Description of regulatory framework established by the Hatch Waxman Act and the economics of drug pricing and distribution.

Expert disclosure: April 2016

Deposition: April 2016

In re: Solodyn (Minocycline Hydrochloride) Antitrust Litigation, United States District Court, District of Massachusetts, MDL No. 14-md-2503-DJC

Allegations: The Medicis-Impax settlement of patent litigation related to the drug Solodyn included anticompetitive reverse payments.

Assignment: Analysis of agreements.

Expert reports: May 2017, August 2017, February 2018

Deposition: September 2017

Trial Testimony: March 2018

In re: Asacol Antitrust Litigation, United States District Court, District of Massachusetts, Civil Action No. 1:15-cv-12730-DJC

Allegations: Warner Chilcott engaged in an anticompetitive product hop from Asacol to Delzicol.

Assignment: Analysis of product hop.

Expert reports: June 2017, August 2017

Deposition: August 2017

United States of America ex rel., Stephen A. Krahling and Joan Wlochowski v. Merck & Co., Inc., United States District Court for the Eastern District of Pennsylvania, Civil Action No. 10-4374 (CDJ) and *In re Merck Mumps Vaccine Antitrust Litigation*, United States District Court for the Eastern District of Pennsylvania, Master File No. 2:12-cv-03555 (CDJ)

Allegations: Merck made misrepresentations and omissions to the Food and Drug Administration related to the efficacy testing of its Mumps vaccines.

Assignment: Analysis of market power and estimation of harm to private purchasers.

Expert report: March 2018

Deposition: July 2018

In re: Niaspan Antitrust Litigation, United States District Court for the Eastern District of Pennsylvania, MDL No. 2:13-md-2460

Allegations: AbbVie, Inc., entered into an illegal exclusionary payment agreement with Teva Pharmaceuticals USA, Inc., to delay generic competition for extended-release niacin (niacin ER).

Assignment: Analysis of market power and definition.

Expert reports: May 2018, October 2018, February 2019

Deposition: April 2019

In re: Loestrin 24 FE Antitrust Litigation, United States District Court for the District of Rhode Island, MDL No. 2472

Allegations: The Warner Chilcott-Watson settlement of patent litigation related to the drug Loestrin 24 included anticompetitive reverse payments and that Warner Chilcott engaged in an anticompetitive product hop from Loestrin 24 to Minastrin 24.

Assignment: Analysis of settlement agreements and product hop.

Expert reports: January 2019, March 2019

Deposition: April 2019

In re: Opana ER Antitrust Litigation, United States District Court for the Northern District of Illinois, Eastern Division, MDL No. 2580

Allegations: The Endo-Impax settlement of patent litigation related to the drug Opana ER included anticompetitive reverse payments.

Assignment: Analysis of settlement agreements.

Expert reports: March 2019, November 2019

Deposition: May 2019, December 2019

In re: National Prescription Opiate Litigation, MDL No. 2804, Case No. 17-md-2804

Allegations: Defendants fraudulently marketed opioid products and did not report shipments.

Assignment: Calculation of damages for bellwether counties; identification and valuation of public nuisance outcomes.

Expert report: March 2019

Deposition: May 2019

In re: Intuniv Antitrust Litigation, United States District Court for the District of Massachusetts, C.A. No. 16-cv-12653-ADB; 17-cv-10050-ADB

Allegations: The Shire-Barr settlement of patent litigation related to the drug Intuniv included anticompetitive reverse payments.

Assignment: Analysis of settlement agreements.

Expert reports: March 2019, June 2019

Deposition: July 2019

State of Washington v. Purdue Pharma L.P.; Purdue Pharma Inc.; The Purdue Frederick Company; et al., State of Washington, King County Superior Court, No. 17-2-25505-0 SEA

Allegations: Purdue fraudulently marketed opioid products.

Assignment: Identification and valuation of public nuisance outcomes.

Expert report: July 2019

In re: Restasis (cyclosporine ophthalmic emulsion) Antitrust Litigation, United States District Court for the Eastern District of New York, MDL No. 18-md-2819 (NG)(LB)

Allegations: Allergan used a variety of tactics to delay generic entry for the drug Restasis.

Assignment: Analysis of market power and definition.

Expert reports: August 2019, December 2019

Deposition: June 2020

In re: Zetia (ezetimibe) Antitrust Litigation, United States District Court for the Eastern District of Virginia, Norfolk Division, MDL No. 2:18-md-2836

Allegations: The Merck-Glenmark settlement of patent litigation related to the drug Zetia included anticompetitive reverse payments.

Assignment: Analysis of settlement agreements.

Expert reports: January 2020, April 2020

In re: Glumetza Antitrust Litigation, United States District Court for the Northern District of California, Case No.: 3:19-cv-05822-WHA

Allegations: The defendants (Assertio, Bausch, Depomed, Santarus and Valeant) settlement of patent litigation related to the drug Glumetza included anticompetitive reverse payments.

Assignment: Analysis of settlement agreements; drug pricing patterns.

Expert reports: June 2020, July 2020

Deposition: July 2020

Appendix B

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Appendix B: Materials Relied Upon and Considered

Bates Documents

CCDS_0081519
CCDS_0081523
CCDS_0081527
CCDS_0081531
CCDS_0081533
HUNT_00027750
HUNT_00028762
HUNT_00028960
HUNT_00028961
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HUNT_00030093
HUNT_00030096
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HUNT_00089822
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HUNT_00096300
HUNT_00099227
HUNT_00197045-55
HUNT_00225171
HUNT_00321072
HUNT_00321073
HUNT_00943495
HUNT_00943496
HUNT_00943497
HUNT_00943498
HUNT_01515584
HUNT_01718156

Legal Documents

Corrected Joint and Third Amended Complaint, *In re: National Prescription Opiate Litigation as it relates to Cabell County Commission and City of Huntington, West Virginia*, Case No. 1:17-op-45053-DAP (S.D. W.Va.) and Case No. 1:17-op-45054 (S.D. W.Va.), in the United States District Court for the Northern District of Ohio, Eastern Division, September 16, 2019.

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Deposition of Beth Thompson, in this matter, July 7, 2020.
Deposition of Charles Zerkle, in this matter, June 17, 2020.
Deposition of Craig Preece, in this matter, July 14th, 2020.
Deposition of Hank Dial, in this matter, June 25, 2020.
Deposition of Jan Rader, in this matter, June 17, 2020.
Deposition of Kathleen Napier, in this matter, July 7, 2020.
Deposition of Paul Hunter, in this matter, July 1, 2020.
Deposition of Raymond Carafax, in this matter, June 16, 2020.
Deposition of Scott Lemley, in this matter, July 3, 2020.
Deposition of Steve Williams, in this matter, June 30, 2020.
Deposition of Sue Ann Painter, in this matter, June 26, 2020.
Expert Report of Craig J. McCann, Ph.D., CFA, in this matter, August 3, 2020.
Expert Report of Dr. Corey Waller, in this matter, August 3, 2020.
Expert Report of Ellen Thompson, M.D., in this matter, August 3, 2020.
Expert Report of Professor Katherine Keyes, in this matter, August 3, 2020.
Expert Report, Anna Lembke, M.D., in this matter, August 3, 2020.
Expert Report, Gordon Smith, M.D., in this matter, August 3, 2020.

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Meetings and calls

3/4/2020: In-person meeting with counsel and Dr. Lyn O’Connell, Chief Jan Rader, Mayor Steve Williams, Captain Rocky Johnson, Dr. Zach Hansen, Dr. Todd Davies, Dr. Chaffin.

3/31/2020-7/31/2020: Calls with counsel and

- David Chaffin, MD, FACOG, Professor, Marshall University
- Ray Cornwell, City of Huntington Police Captain
- Hank Dial, City of Huntington Police Chief
- Todd Davies, PhD, Marshall University Assistant Professor; Cabell-Huntington Coalition for the Homeless, Executive Director
- Zach Hansen, MD, Doctor, Valley Health
- Tim Hardesty, Assistant Superintendent, Division of District Support and Employee Relations, Cabell County Schools
- Rocky Johnson, City of Huntington Police Department, Police Captain, Special Investigations Bureau (Former)
- Michael Kilkenny, MD, Director, Cabell County Department of Public Health
- Marcia Knight, Director of Education, Cabell County EMS
- Sean Loudin, MD, Associate Professor, Marshall University School of Medicine
- Gordon Merry, Cabell County EMS Director
- Steve Murray, Assistant Director, Cabell County EMS
- Lyn O’Connell, PhD, Associate Director of Addiction Sciences, Marshall Health
- Stephen Petrany, MD, Chair of Family & Community Health, Marshall University School of Medicine
- Jan Rader, City of Huntington Fire Chief
- Keith Thomas, Coordinator of Student Support, Cabell County Schools
- Ellen A. Thompson, MD, Professor, Marshall Health, Huntington, West Virginia
- Kelly Watts, Assistant Superintendent, Division of Instruction and Leadership, Cabell County Schools
- Beth Welsh, Marshall University Associate Director of Operations for Addiction Sciences in Family Medicine
- Steve Williams, Mayor of Huntington
- Chuck Zerkle, Cabell County Sheriff

Appendix C

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Appendix C

This Appendix provides the sources used and analysis undertaken for the calculation of the harms identified in the Report. This Appendix is organized as follows:

Section I	Mortality
Section II	Morbidity
Section III	Neonatal Abstinence Syndrome
Section IV	Crime
Section V	Child Maltreatment

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Section I

Mortality

1. In this section, I describe the use of the concept of the Value of a Statistical Life (VSL) used to quantify the valuation of deaths due to the sales and distribution of prescription opioids. The VSL is derived from an individual's willingness to pay (WTP) for a reduction in the risk of injury or death.¹ WTP is estimated via revealed-preference methods using labor market data that measure the wage-risk tradeoff.² WTP can also be directly measured using surveys that require respondents to express their risk-reduction preferences.³ An individual's risk-reduction WTP may vary based on factors such as risk-tolerance, preferences, age, health status, and other factors. For example, some studies find that the age-distribution of VSL takes the form of an inverted U,⁴ implying that the VSL is highest for individuals in the 25-55 age range.

2. The methodology I use for deriving a VSL is based on guidance from the Assistant Secretary for Planning and Evaluation (ASPE) of the U.S. Department of Human and Health Services (HHS), the federal agency responsible for evaluating health-related policies in the U.S.⁵ HHS recommends a VSL of \$9.3 million in 2014 dollars (with no age adjustment) as its main national estimate, although the HHS recognizes there is a range for VSL estimates that might be considered.⁶ For purposes of my Report, I will use the central \$9.3 million estimate for 2014,

¹ L.A. Robinson and J.K. Hammitt, "Valuing Reductions in Fatal Illness Risks: Implications of Recent Research," *Health Economics*, 25, 2016, pp. 1039-1052.

² C.R. Scotton, "New Risk Rates, Inter-industry Differentials and the Magnitude of VSL Estimates," *Journal of Benefit-Cost Analysis*, 4(1), 2013, pp. 39-80.

³ T.A. Cameron and J.R. DeShazo, "Demand for Health Risk Reductions," *Journal of Environmental Economics and Management*, 65, 2013, pp. 87-109.

⁴ J.K. Hammitt, "Valuing Changes in Mortality Risk: Lives Saved Versus Life Years Saved," *Review of Environmental Economics and Policy*, 1(2), 2007, pp. 228-240.

⁵ Office of the Assistant Secretary for Planning and Evaluation (ASPE), U.S. Department of Health and Human Services (HHS), "Guidelines for Regulatory Impact Analysis," 2016, (hereafter HHS 2016 Guidelines) (https://aspe.hhs.gov/system/files/pdf/242926/HHS_RIAGuidance.pdf). ASPE does not recommend adjusting the VSL for the age of the individual.

⁶ See HHS 2016 Guidelines, p. 15. HHS also recommends conducting sensitivity analyses with a low and high VSL estimate of \$4.4 million and \$14.2 million (in 2014 dollars), respectively. Other federal agencies also use VSL estimates to evaluate policy interventions. The methods proposed are broadly similar, but sometimes differ in the specific assumptions used. Note also that the estimates discussed next are for other years around 2014. For example, the Department of Transportation recommends using a different deflator specification, but assumes income elasticity of VSL is 1.0, and base VSL is \$9.1 million in 2013 dollars. With their methodology, the VSL recommended for 2014 is \$9.2 million. See U.S. Department of Transportation (DOT), "Revised Departmental

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but also show how the results would vary based on the upper and lower ends of the recommended range.⁷ The Council of Economic Advisor's (CEA) recent report entitled "The Underestimated Cost of the Opioid Crisis," uses VSL-based estimates of the economic cost of a death very similar to those used in my Report.⁸

3. The national estimate for 2014 can be used as a basis for estimating the VSL for different years by applying a price-level adjustment and adapting to different geographic areas by applying an income adjustment. Specifically, the VSL for Cabell County in year t (2006, ..., 2018), VSL_{ct} , is estimated based on the HHS-recommended methodology, via Equation (1):

$$VSL_{ct} = VSL_{2014} * \frac{CPI_t}{CPI_{2014}} * \left(1 + \left[\epsilon * \frac{(Y_{ct} - Y_{2014})}{(Y_{ct} + Y_{2014})/2} \right] \right) \quad (1)$$

Where

- VSL_{2014} = National Value of a Statistical Life in 2014
- CPI_t = National Consumer Price Index for the year t
- CPI_{2014} = National Consumer Price Index for 2014
- ϵ = Income elasticity of Value of a Statistical Life
- Y_{2014} = National median income in 2014
- Y_{ct} = Median income in Cabell County at time t

4. The $VSL_{2014} = \$9.3m$ is from the HHS recommendations as indicated above. The CPI for the years 2006 through 2018 is the Consumer Price Index for All Urban Consumers Current

Guidance 2016: Treatment of the Value of Preventing Fatalities and Injuries in Preparing Economic Analyses," 2016 (hereafter DOT 2016 Guidance), (<https://www.transportation.gov/sites/dot.gov/files/docs/2016%20Revised%20Value%20of%20a%20Statistical%20Life%20Guidance.pdf>). The Environmental Protection Agency (EPA) guidelines are based on a review of the VSL literature. They aggregate 88 VSL estimates and derive a series of summary statistics of these numeric estimates using a variety of statistical approaches, settling on a central estimate of \$10.3 million for 2013 dollars. See U.S. Environmental Protection Agency, "Valuing Mortality Risk Reductions for Policy: A Meta-Analytic Approach," 2016 (hereafter EPA 2016).

⁷ The HHS 2016 Guidelines provide a VSL lower bound estimate of \$4.4m and upper bound of \$14.2m. In footnote 63 of my Report, I report the estimated harm due to mortality using the low and high estimates noted here.

⁸ Council of Economic Advisors, "The Underestimated Cost of the Opioid Crisis," 2017 (hereafter CEA Report) (<https://www.whitehouse.gov/sites/whitehouse.gov/files/images/The%20Underestimated%20Cost%20of%20the%20Opioid%20Crisis.pdf>). The CEA Report provides \$9.6 million in 2015 as its "middle" estimate, while showing results for higher and lower values of VSL as well. See CEA Report, pp. 6-7.

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Series from the Bureau of Labor Statistics.⁹ The parameter ϵ for the income elasticity is assumed to be 1.0 following HHS recommendations, recommendations in line also with those of the Department of Transportation.¹⁰ The source of national and county median income is the Census Bureau's American Community Survey 1-year estimates.¹¹

5. The interpretation of the VSL for a year from Equation (1) is the median valuation a resident of the county would put on the loss of life, measured in current dollars. Equation (1) adjusts the national figure for VSL in 2014 for changes in price levels between years and differences in median income between the 2014 national estimate and the year-specific county estimate. The ratio of the CPIs adjusts for prices. In years prior to 2014, for example, this ratio will be less than one, tending to factor down the VSL. The product of the elasticity ϵ and the percentage difference in the county-year specific income and the national base year for 2014 adjusts the VSL for changes in valuation that would accompany higher incomes. The assumption of $\epsilon = 1.0$ means that the increase in valuation of the VSL moves in proportion to income. A one percent increase in income leads to a one percent increase in the VSL.

6. Table C.I.1 shows the income and price-level adjusted VSL for Cabell County for 2006-2018 in row [4], reflecting Equation (1).

⁹ CPI data is available from the Bureau of Labor Statistics (<https://www.bls.gov/cpi/data.htm>). I use the All Urban Consumer Current Series CUSR0000SA0. HHS recommends using the CPI to adjust for inflation. See HHS 2016 Guidelines, p.38.

¹⁰ DOT 2016 Guidance, p. 9. Note that the EPA recommends a value of 0.7, with a range of 0.1 to 1.7 (EPA 2016, p. 10). Because income in Cabell County is below the national average, a value of income elasticity at the higher end of the range, 1.0, is conservative in this context. It makes the Cabell County VSL "more responsive" to differences in the income level between Cabell County and the national average.

¹¹ U.S. Census Bureau, 2006-2017 American Community Survey 1-Year Estimates (Subject Table S1901) (available from <https://data.census.gov/>).

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Table C.I.1
Adjusted Value of a Statistical Life for Cabell County
2006-2018

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
[1] CPI/CPI ₂₀₁₄	0.85	0.88	0.91	0.91	0.92	0.95	0.97	0.98	1.00	1.00	1.01	1.04	1.06
[2] Adjusted VSL (\$millions)	\$7.9	\$8.1	\$8.5	\$8.4	\$8.6	\$8.8	\$9.0	\$9.2	\$9.3	\$9.3	\$9.4	\$9.6	\$9.9
[3] Median Income (Cabell County)	34,943	31,592	32,008	34,684	36,153	37,279	35,567	39,019	34,046	38,839	38,823	33,750	38,162
[4] Cabell County VSL (\$millions)	\$4.6	\$3.9	\$4.2	\$4.8	\$5.2	\$5.7	\$5.4	\$6.3	\$5.1	\$6.3	\$6.4	\$5.2	\$6.5

Notes and Sources

[1] = $[CPI_t] / [CPI_{2014}]$. CPI data available from <https://www.bls.gov/cpi/data.htm>; utilized the All Urban Consumer Current Series CUSR0000SA

[2] = $[VSL_{2014}] * [1]$

[3] = Source: National Median Income, The U.S. Census Bureau, 2006-2017, American Community Survey 1-Year Estimates series # 1901

[4] = $(\text{National VSL}_{2014}) * (CPI_t / CPI_{2014}) * \{ 1 + [e * \{ ([Cabell \text{ Median Income}] - [National \text{ Median Income}_{2014}]) / ([Cabell \text{ Median Income}] + [National \text{ Median Income}_{2014}]) / 2 \}] \}$

7. The effects of replacing the \$9.3 million central estimate for the national VSL with the lower and upper bounds can be readily calculated. The lower bound factors down the estimate by \$4.4/\$9.3 million and the upper bound factors it up by \$14.2/\$9.3 million. The resulting estimates for the cost of mortality are contained in the main body of my Report.

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Section II

Morbidity

8. This Section summarizes my approach to estimating excess health care costs resulting from opioid use disorder (OUD) in Cabell County. Studies of the excess costs of treatment of OUD are summarized in Table C.II.1. These studies apply a cost-of-illness methodology to compare total health care costs for those with OUD with a sample of matched controls.

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Health Care Cost Studies**

Study	Year [12]	Patient Population Studied	Additional Annual Cost for OUD Individuals
[1] Birnbaum <i>et al.</i> (2006)	2001	Commercial	\$9,449
[1] Birnbaum <i>et al.</i> (2006)	2001	Publicly Insured	\$12,394
[1] Birnbaum <i>et al.</i> (2006)	2001	Uninsured	\$4,566
[2] McAdam-Marx <i>et al.</i> (2010)	2002-2003	Medicaid	\$5,874
[3] White <i>et al.</i> (2005)	2003	Commercial	\$14,054
[4] Roland <i>et al.</i> (2019)	2011	Medicare	\$24,230
[5] Rice <i>et al.</i> (2014)	2012	Commercial	\$11,376
[6] Florence <i>et al.</i> (2016)	2013	Commercial	\$15,500
[6] Florence <i>et al.</i> (2016)	2013	Medicare	\$17,052
[6] Florence <i>et al.</i> (2016)	2013	Medicaid	\$13,743
[7] Kirson <i>et al.</i> (2017)	2015	Commercial	\$14,810
[8] Scarpati <i>et al.</i> (2017)	2015	Commercial	\$15,764
[9] Scarpati <i>et al.</i> (2017)	2015	Commercial	\$10,989
[10] Leslie <i>et al.</i> (2019)	2017	Medicaid	\$6,485
[11] Davenport <i>et al.</i> (2019)	2018	Overall health care	\$14,846
[11] Davenport <i>et al.</i> (2019)	2018	Medicare	\$17,681
[11] Davenport <i>et al.</i> (2019)	2018	Commercial	\$22,185
[11] Davenport <i>et al.</i> (2019)	2018	Medicaid	\$9,016

Notes and Sources

[1] H. G. Birnbaum *et al.*, "Estimated Costs of Prescription Opioid Analgesic Abuse in the United States in 2001: a Societal Perspective," *The Clinical Journal of Pain*, 22(8), 2006, pp. 667-676.

[2] C. McAdam-Marx, *et al.*, "Costs of Opioid Abuse and Misuse Determined from a Medicaid database," *Journal of Pain & Palliative Care Pharmacotherapy*, 24(1), 2010, pp. 5-18.

[3] A. G. White, *et al.*, "Direct Costs of Opioid Abuse in an Insured Population in the United States," *Journal of Managed Care Pharmacy*, 11(6), 2005, pp. 469-479.

[4] C. L. Roland, *et al.*, "The Prevalence and Cost of Medicare Beneficiaries Diagnosed and At Risk for Opioid Abuse, Dependence, and Poisoning," *Journal of Managed Care & Specialty Pharmacy*, 25(1), 2019, pp. 18-27.

[5] J. B. Rice, *et al.*, "The Economic Burden of Diagnosed Opioid Abuse Among Commercially Insured Individuals," *Postgraduate Medicine*, 126(4), 2014.

[6] C. S. Florence, *et al.*, "The Economic Burden of Prescription Opioid Overdose, Abuse and Dependence in the United States, 2013," *Medical Care*, 54(10) 2016.

[7] N. Y. Kirson, *et al.*, "The Economic Burden of Opioid Abuse: Updated Findings," *Journal of Managed Care and Specialty Pharmacy*, 23(4), 2017, pp. 427-45.

[8] L. M. Scarpati, *et al.*, "Opioid Abuse: A Detailed Examination of Cost Drivers over a 24-Month Follow-up Period," *Journal of Managed Care & Specialty Pharmacy*, 23(11), 2017, pp. 1110-15.

[9] L. M. Scarpati, *et al.*, "Drivers of Excess Costs of Opioid Abuse Among a Commercially Insured Population," *American Journal of Managed Care*, 23(5), 2017, pp. 276-282.

[10] D. L. Leslie, *et al.*, "The Economic Burden of the Opioid Epidemic on States: The Case of Medicaid," *The American Journal of Managed Care*, Supplement 25(13), 2019, pp. S243-249.

[11] S. Davenport, A. Weaver, and M. Caverly, "Economic Impact of Non-Medical Opioid Use in the United States Annual Estimates and Projections for 2015 through 2019," *Society of Actuaries*, 2019.

[12] The year listed reflects the year in which dollar cost estimates are measured, not necessarily the year from which the data originate.

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9. Recent studies by Leslie, *et al.* (2019) and Davenport, *et al.* (2019) contain pertinent data from which I derive estimates of excess health care costs.¹² Leslie, *et al.* use Medicaid data from 17 states to estimate the excess costs for the years 1999-2013, reported in 2017 dollars. Results, from Leslie, *et al.*, for the years 2006 through 2013 are reported in Table C.II.2.

Table C.II.2
ODU Excess Health Care Costs for Persons Covered by Medicaid
from Leslie, *et al.*

	2006	2007	2008	2009	2010	2011	2012	2013
[1] Excess Costs, National (2017 Dollars)	\$ 9,910	\$ 9,433	\$ 8,591	\$ 8,606	\$ 8,778	\$ 7,937	\$ 7,556	\$ 6,485

Notes and Sources

[1] Source: D.L. Leslie, *et al.*, “The Economic Burden of the Opioid Epidemic on States: The Case of Medicaid,” *The American Journal of Managed Care*, Supplement 25(13), 2019, pp. S243-249

10. Davenport, *et al.* use large national databases available to the Society of Actuaries to estimate excess health care costs associated with OUD by payer for 2015-2018.¹³ Results for three major groups of payers are reported in the first three rows of Table C.II.3, taken from Davenport, *et al.* Figure 6, followed by West Virginia estimated excess costs for commercial and Medicare patients, taken from Davenport, *et al.*, Figures A6-A8 and A14-A16. The authors do not report West Virginia-specific Medicaid excess health care costs.

11. The results from Davenport, *et al.* imply that from 2015-2018, per person excess health care costs in West Virginia are 39.0% lower than the national average.¹⁴ Additionally, the Davenport, *et al.* data imply that excess health care costs per person with OUD are on average 224% higher for Medicare and commercial patients relative to Medicaid patients.¹⁵

¹² D.L. Leslie, *et al.*, “The Economic Burden of the Opioid Epidemic on States: The Case of Medicaid,” *The American Journal of Managed Care*, Supplement 25(13), 2019, pp. S243-249 (hereafter Leslie, *et al.*) and S. Davenport, A. Weaver, and M. Caverly, “Economic Impact of Non-Medical Opioid Use in the United States Annual Estimates and Projections for 2015 through 2019,” *Society of Actuaries*, 2019 (hereafter Davenport, *et al.*).

¹³ The authors rely on health care claims data. For individuals with commercial insurance, they use IBM Watson Health’s MarketScan. For Medicaid Managed Care and Medicare Advantage patients, they use Millman’s

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Table C.II.3
OUD Excess Health Care Costs Across Payers Nationally and in West Virginia
Based on Davenport, *et al.*

	2015	2016	2017	2018
[1] Commercial	\$20,612	\$21,346	\$21,771	\$22,185
[2] Medicare	\$16,129	\$17,021	\$17,351	\$17,681
[3] Medicaid	\$8,062	\$8,549	\$8,847	\$9,016
[4] West Virginia Commercial	\$11,467	\$11,913	\$12,220	N/A
[5] West Virginia Medicare	\$10,974	\$11,401	\$11,695	N/A
Percent difference between West Virginia [6] and national commercial and Medicare average costs	38.9%	39.2%	38.9%	39.0%
[7] Percent difference between Medicaid and commercial and Medicare costs	228%	224%	221%	224%

Notes and Sources

Costs are in nominal dollars. 2018 figures are averages of 2015-2017

[1] - [5] Source: S. Davenport, A. Weaver, and M. Caverly, "Economic Impact of Non-Medical Opioid Use in the United States Annual Estimates and Projections for 2015 through 2019," Society of Actuaries, 2019

[6] = $1 - ([4] + [5]) / ([1] + [2])$. 2018 estimate is the average of 2015 - 2017

[7] = $[([1] + [2]) / 2] / [3]$. 2018 estimate is the average of 2015 - 2017

12. I combine the results from the Leslie, *et al.* and Davenport, *et al.* studies to construct a West Virginia excess cost estimate for a combined Medicaid/Uninsured group and a combined Medicare/Commercial group from 2006 through 2018. Specifically, I begin with the Leslie, *et*

Consolidated Health Costs Guidelines Sources Database, and for fee-for-service Medicare patients, they use CMS' 5% sample.

¹⁴ This is derived by dividing the sum of West Virginia Medicare and commercial per-patient costs by the National Medicare and commercial per-patient costs. Because 2018 West Virginia data is unreported, I use the average of 2015-2017 costs as an approximation for 2018.

¹⁵ I calculate this difference by dividing the average of the commercial and Medicare costs by the Medicaid average costs for 2015-2018. This results in line [7] of Table C.II.3

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al. Medicaid excess cost estimates, and use the data (in 2017 dollars) for the final year of data in that study (2013) as an estimate of the excess costs for the years 2014-2018. I then reduce these national cost estimates by 39.0% to reflect lower health care costs in West Virginia, as shown in the first row of Table C.II.4. Next, based on the Davenport, *et al.* finding that Medicare/Commercial costs are 224.5% higher than Medicaid, I construct a series for Medicare/Commercial excess costs over the same time period, shown in the second row of the table.

Table C.II.4
West Virginia Excess Health Care Costs for Persons with OUD
2006-2018

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
[1] Medicaid excess costs (national)	\$9,910	\$9,433	\$8,591	\$8,606	\$8,778	\$7,937	\$7,556	\$6,485	\$6,485	\$6,485	\$6,485	\$6,485	\$6,485
% difference between West Virginia and national average costs (commercial and Medicare)	39.0%	39.0%	39.0%	39.0%	39.0%	39.0%	39.0%	39.0%	39.0%	39.0%	39.0%	39.0%	39.0%
[3] Medicaid/Uninsured excess costs	\$6,044	\$5,753	\$5,240	\$5,249	\$5,354	\$4,841	\$4,609	\$3,955	\$3,955	\$3,955	\$3,955	\$3,955	\$3,955
% difference between Medicaid and commercial and Medicare costs	224.5%	224.5%	224.5%	224.5%	224.5%	224.5%	224.5%	224.5%	224.5%	224.5%	224.5%	224.5%	224.5%
[5] Medicare/Commercial excess costs	\$13,567	\$12,914	\$11,761	\$11,781	\$12,017	\$10,866	\$10,344	\$8,878	\$8,878	\$8,878	\$8,878	\$8,878	\$8,878

Notes and Sources: Costs are in 2017 US Dollars

[1] C.II.2, Row [1]. Data for 2014-2018 is unavailable, assumed to be equal to 2013

[2] C.II.3, Row [6], average over 2015-2017

[3] = [1] * (1 - [2])

[4] C.II.2, Row [7], average over 2015-2017

[5] = [3] * [4]

13. The next step is to estimate of the distribution of individuals in West Virginia with OUD falling into the Medicaid/Uninsured and Medicare/Commercial categories. I rely on data from the Healthcare Cost and Utilization Project (HCUP) pertaining Opioid-Related Hospital Use.¹⁶ Data for 2018 are not available, so I proxy it with 2017 data. As shown in Table C.II.5, by the

¹⁶ HCUP Fast Stats, Healthcare Cost and Utilization Project (HCUP), December 2019, Agency for Healthcare Research and Quality, Rockville, MD (<https://www.hcup-us.ahrq.gov/faststats/OpioidUseServlet?radio-1=on&radio-3=on&location1=WV&characteristic1=06&setting1=IP&location2=&characteristic2=01&setting2=IP&expansionInfoState=hide&dataTablesState=hide&definitionsState=hide&exportState=hide#export>).

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end of the period, Medicaid/Uninsured constitute two-thirds of the share of hospital admissions for OUD.¹⁷ I approximate the share of individuals with OUD in Cabell County with Medicaid/Uninsured and Medicare/Commercial coverage by the share of these payers of admissions for OUD in West Virginia.

Table C.II.5
HCUP Data – West Virginia Opioid-Related Inpatient Admissions by Payer
2006-2018

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
[1] Medicaid/Uninsured	56.4%	61.0%	56.3%	56.3%	60.7%	59.1%	61.1%	62.3%	65.1%	65.5%	65.6%	68.0%	68.0%
[2] Medicare/Commercial	43.6%	39.0%	43.8%	43.8%	39.3%	40.9%	38.9%	37.7%	34.9%	34.5%	34.4%	32.0%	32.0%

Notes and Sources:

[1] - [2] HCUP Opioid Related Inpatient Data for West Virginia

14. Next, I use the shares from Table C.II.5 to apportion OUD cases in Cabell into the two payer groups, effectively assuming that the share of discharges by payer in Cabell is similar to the state, and that the share of discharges is a good proxy for the share of cases. I then multiply the number of cases in each category by the excess cost for that category to come up a total. Table C.II.6 below contains these calculations, also shown as Table 5 of my Report.

¹⁷ The Kaiser Family Foundation (KFF) reports a Medicaid/uninsured share 58% by 2017 for non-elderly adults. Because Medicare and commercially insured patients incur higher costs, my use of the HCUP data is conservative in relation to the KFF estimates. See K. Orgera, and J. Tolbert, “The Opioid Epidemic and Medicaid’s Role in Facilitating Access to Treatment,” *Kaiser Family Foundation*, 2018: (<https://www.kff.org/medicaid/issue-brief/the-opioid-epidemic-and-medicare-roles-role-in-facilitating-access-to-treatment/>).

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Table C.II.6
Excess Health Care Costs Attributed to Individuals with Prescription OUD
2006-2018

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
[1] Total OUD cases due to prescription opioids	3,859	5,952	3,433	3,773	4,985	6,230	3,530	7,218	6,020	7,240	7,148	9,018	7,109	75,515
[2] Share of OUD cases covered by Medicare/commercial payers	43.6%	39.0%	43.8%	43.8%	39.3%	40.9%	38.9%	37.7%	34.9%	34.5%	34.4%	32.0%	32.0%	
[3] Share of OUD cases covered by Medicaid/uninsured	56.4%	61.0%	56.3%	56.3%	60.7%	59.1%	61.1%	62.3%	65.1%	65.5%	65.6%	68.0%	68.0%	
Excess health care costs per														
[4] OUD case covered by Medicare/commercial payers	\$13,567	\$12,914	\$11,761	\$11,781	\$12,017	\$10,866	\$10,344	\$8,878	\$8,878	\$8,878	\$8,878	\$8,878	\$8,878	
Excess health care costs per														
[5] OUD case covered by Medicaid/uninsured	\$6,044	\$5,753	\$5,240	\$5,249	\$5,354	\$4,841	\$4,609	\$3,955	\$3,955	\$3,955	\$3,955	\$3,955	\$3,955	
Total excess health care costs due to prescription opioids (\$ mil)	\$36.0	\$50.9	\$27.8	\$30.6	\$39.8	\$45.5	\$24.2	\$41.9	\$34.2	\$40.9	\$40.4	\$49.9	\$39.3	\$501.3

Notes and Sources

[1] Source: Keyes Report, Figure 14

[2] & [3] Source: Table C.II.5

[4] & [5] Source: Table C.II.4

[6] = [1] * [2] * [4] + [1] * [3] * [5]

15. Table C.II.7 summarizes some of the literature studying the impact of prescription opioids on labor market participation. To compare estimates across studies, I scaled each study's estimate to represent the impact of a 10% increase in opioid prescribing on employment rates. Krueger 2017¹⁸ reports the impact of a 10% increase in MME per capita; the other studies all report the impact of a 10% increase in opioid prescriptions per capita. MME per capita grew more than opioid prescriptions per capita over the time period.

¹⁸ A.B. Krueger, "Where Have all the Workers Gone? An inquiry into the Decline of the US Labor Force Participation Rate," *Brookings Papers on Economic Activity*, 2017(2), 2017, pp. 1-43.

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Table C.II.7
Empirical Studies on the Impact of Opioids on Employment

Study	Impact of 10% increase in prescribing
[1] A.B. Krueger, “Where Have all the Workers Gone? An inquiry into the Decline of the US Labor Force Participation Rate.” <i>Brookings Papers on Economic Activity</i> , 2017.2, 2017. Table 13	–0.011 (males) –0.014 (females)
[2] J. Currie, J. Jin, and M. Schnell, “US Employment and Opioids: Is There a Connection?,” <i>Health and Labor Markets, Research in Labor Economics</i> , 47, 2019, pp. 253-280	0.005 (females) no impact for males
[3] M.C. Harris, <i>et al.</i> , “Prescription Opioids and Labor Market Pains: the Effect of Schedule II Opioids on Labor Force Participation and Unemployment,” <i>Journal of Human Resources</i> , 2019, pp. 1017-9093R2	–0.056 (males and females)
[4] D. Aliprantis, K. Fee, and M. Schweitzer, “Opioids and the Labor Market,” 2019	–0.050 (males) –0.017 (females)

Notes and Sources

[1] Krueger 2017 used county-level MME per capita data in 2015 and county-level labor force participation data for men and women age 25 to 54 from 1996–2001 and 2014–2016. Krueger regressed labor force participation rates on log MME per capita, a dummy for 2014–2016, and an interaction between log MME per capita and the dummy for 2014–2016. Krueger also controlled for race and ethnicity, marital status, age and age-squared, years of education, share of manufacturing employment and an interaction between share of manufacturing employment and the dummy for 2014–2016, region dummy variables, and county fixed effects

[2] Currie, Jin, and Schnell 2018 used IQVIA prescriptions data and Quarterly Workforce Indicators employment data from 2006–2014. Currie and colleagues instrument for county per capita opioid prescriptions to working-age people using per capita opioid prescriptions to age 65 and older of the same gender. They regress predicted log employment rates of men and women age 19 to 64 on log opioid prescriptions per capita (predicted using their instrument), percent with health insurance, year fixed effects, and county fixed effects at the county level. They also stratify by low vs. high education counties—the results for low education counties are presented in the table above

[3] Harris, Kessler, Murray, and Glenn 2019 use county-level opioid prescription rates from prescription drug monitoring programs and controlled substance monitoring programs in ten states (Arkansas, California, Colorado, Florida, Massachusetts, Michigan, Ohio, Oregon, Tennessee, and Texas) from 2010 to 2015. Harris and colleagues use county-level labor force and employment rates from the Bureau of Labor Statistics. They instrument for county-level opioid prescribing using each county’s per capita number of physicians with opioid prescribing rates above the 95th percentile in Medicare Claims data. They regress county employment-to-population ratios in each year on opioid prescriptions per capita (predicted using their instrument). They also control for county characteristics (percent rural, percent female, percent Black, percent Hispanic, percent in each 10-year age bracket, per capita number of primary care physicians, and per capita cancer deaths)

[4] Aliprantis, Fee, and Schweitzer 2019 used CDC county-level opioid prescribing data and labor force participation data from the 1% American Community Survey sample from 2006 to 2016. The aggregate data is up to the Public Use Microdata Area (PUMA) level; PUMAs are the lowest available geographic identifier which covers all the US in ACS data. They regress labor force participation rates and employment to population ratios in each year on one-year lagged log opioid prescriptions per capita for males and females. They control for labor demand shocks, baseline labor force participation rates and employment to population ratios in 2000, share in manufacturing employment, a fourth-order polynomial in average age, percent with less than high school, high school, and some college education, percent White, Black, and Hispanic, percent married, region, and state fixed effects

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Section III

Neonatal Abstinence Syndrome (NAS)

16. In this Section, I describe the methodology used to quantify the additional health care costs at birth, and through early childhood, of NAS cases attributable to prescription opioid sales and distribution.

17. The difference in the average hospital charges for a birth in Cabell County and the average charge for an NAS birth in Cabell County are used as a basis to estimate the excess costs for NAS births.¹⁹ These are presented in rows 2 and 3 of Table C.III.1. Charges are not costs incurred by payers. To estimate NAS hospital costs to payers (in essence, hospital revenue), I use the net revenue-to-charge ratios from the American Hospital Association. The American Hospital Association publishes aggregate data on gross hospital charges and net patient revenues by state. I use that data for West Virginia, reproduced in rows 5 and 6 of Table C.III.1, to estimate the revenue-to-charge ratio for Cabell County hospitals (row 7), and I use this ratio to estimate the excess costs to payers required to treat NAS babies. Data are unavailable for 2006, so I apply the 2007 estimate. The average excess cost for a case of NAS is reported in row 8 of Table C.III.1.

18. Average excess costs for NAS (row 8) are multiplied by the number of NAS cases in Cabell County attributable to prescription opioids (row 1). This yields total excess hospital costs attributable to NAS resulting from prescription opioid sales and distribution. The total valuation is in row 9 of Table C.III.1, which is \$1.4 million for 2006-2015.

¹⁹ This data for the average charges for all births will include charges for NAS births and therefore is a conservative comparison.

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Table C.III.1
Excess Hospital Costs for NAS
Due to Sales and Distribution of Prescription Opioids
2006-2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
[1] NAS due to prescription opioids	4.9	4.9	7.4	7.9	9.3	11.3	14.1	20.6	20.7	21.5	122.6
[2] Average charge for an NAS birth in WV hospitals	\$11,108	\$11,018	\$11,018	\$16,214	\$21,896	\$32,330	\$43,191	\$43,003	\$51,192	\$59,875	
[3] Average charge for a birth in WV hospitals	\$6,288	\$6,288	\$6,288	\$6,336	\$7,433	\$8,428	\$9,019	\$10,087	\$11,586	\$12,739	
[4] Excess charges for NAS births	\$4,730	\$4,730	\$4,730	\$9,878	\$14,463	\$23,903	\$34,172	\$32,916	\$39,606	\$47,136	
[5] WV gross hospital charges (\$m)	\$7,945	\$8,645	\$9,458	\$10,336	\$11,042	\$11,854	\$12,634	\$13,436	\$14,407	\$15,652	
[6] WV net patient revenue (\$m)	\$3,820	\$4,067	\$4,260	\$4,548	\$4,655	\$4,804	\$5,243	\$5,270	\$5,556	\$5,807	
[7] Patient revenue to charge ratio	48%	47%	45%	44%	42%	41%	41%	39%	39%	37%	
[8] Excess hospital costs per NAS birth	\$2,274	\$2,225	\$2,130	\$4,347	\$6,097	\$9,688	\$14,180	\$12,912	\$15,275	\$17,488	\$86,618
[9] Total Excess WV Hospital Costs for NAS Births	\$11,083	\$10,848	\$15,785	\$34,357	\$56,742	\$109,151	\$199,535	\$266,558	\$316,755	\$375,693	\$1,396,506

19. To quantify the excess health care costs during childhood because of prescription opioid NAS births, I start with research that shows what these costs entail. My main source for these is Liu, *et al.*, which conclude that children ages 1-8 born with NAS incur an average of \$6,927 per year in health care costs. The equivalent figure for children born without NAS is \$2,735, yielding an annual excess health care cost of \$4,192 for children born with NAS.²⁰ I adjust the Liu, *et al* estimates downward to reflect the lower costs incurred by Medicaid, and in West Virginia in the same fashion as the Morbidity section of my Report. Because these costs are annual, I multiply this figure by 8 to obtain the per-child excess health care costs due to NAS.

²⁰ G. Liu, *et al.*, “A longitudinal healthcare use profile of children with a history of neonatal abstinence syndrome,” *The Journal of Pediatrics*, 204, 2019, pp. 111-117. These costs include hospitalizations, emergency department visits, outpatient evaluations, and prescription drugs. Note that these costs are national averages for privately insured children.

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The results of this calculation are in Table 7 of my Report. From 2006-2015, NAS lead to 1.1 million in excess health care costs.

20. I rely on the academic literature to estimate extra costs associated with special education due to being born with NAS. I start by obtaining the general per-student cost of education for children, and the share of children that received special education services, which are approximately \$11,445 for 2014-2015, and 13.2% in 2015-16 respectively.²¹ The cost of special education services per pupil is approximately 1.91 times greater than for students that do not receive special education.²² Students that receive special education receive an average of two years of it.²³ Thus average cost over students that did not receive special education is \$10,218 and that the cost for special education students is \$19,516 ($\$10,218 * 1.91$).²⁴ I use the difference between these two numbers (\$9,298) as the additional special education cost incurred per school year. I combine this with the increased risk of a NAS child requiring special education services (3.9%), yielding an estimate of \$725 ($\$9,298 * 2 * 0.039$) in excess educational cost per student with NAS. This results in a total cost of \$88,862 for 2006-2015. See Table 7 of the Report for the final estimates.

²¹ See: National Center for Education Statistics, Digest of Education Statistics, Table 236.15 for cost per pupil (https://nces.ed.gov/programs/digest/d17/tables/dt17_236.15.asp) and Table 204.30 for percent of total enrollment for children with disabilities (https://nces.ed.gov/programs/digest/d17/tables/dt17_204.30.asp).

²² J.G. Chambers, J. Shkolnik, and M. Perez, "Total Expenditures for Students with Disabilities, 1999-2000: Spending Variation by Disability, Report, Special Education Expenditure Project (SEEP)," 2003, p. v, reports that "Per pupil education expenditures for students who receive special education services (excluding homebound students) are 1.91 times greater than expenditures for students who receive no special education services."

²³ E.W. Holt, D.J. McGrath, W.L. Herring, "Timing and Duration of Student Participation in Special Education in the Primary Grades," *NCES*, 2007(043), Washington DC, National Center for Education Statistics, 2007.

²⁴ Note that the initial average per-student cost (\$11,445) includes children which receive special education. Differencing those students out (13.2% of all students) yields the average per-pupil cost (\$10,218) for students that did not receive special education services.

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Section IV Crime

21. In Section IV.1, I describe the basis for the quantification of crimes attributable to prescription opioid sales and distribution. In Section IV.2, I describe the methodology used to quantify the costs associated with these crimes. In Section IV.3, I describe the approach used to value the effect of crimes on property values.

IV.1. Estimating the Number of Crimes in the Cabell Huntington Community Attributable to the Sales and Distribution of Prescription Opioids

22. To quantifying criminal activity in the Cabell Huntington Community, I calculate the total criminal activity reported for all reporting Law Enforcement Agencies (LEAs). I start with the National Incident-Based Reporting System (NIBRS) data for Cabell County. NIBRS data is a standard source used to measure criminal offenses by category for all law enforcement agencies (LEAs) that report into NIBRS.²⁵ However, starting in 2011, some LEAs in the Cabell Huntington Community did not report to NIBRS.²⁶ In these cases, my staff requested data directly from the LEA. The LEAs for which we obtained data directly include the Huntington Police Department (HPD) and the Cabell County Sheriff's Office (CCSO).²⁷ Barboursville Police Department (BPD) data comes from NIBRS. I use data from NIBRS from 2006-2010,

²⁵ NIBRS is set to replace the Uniform Crime Reporting System (UCR) as the standard data source for the FBI by 2021 (<https://ucr.fbi.gov/nibrs/2018/resource-pages/countdown.pdf>). Other data sources include the FBI's UCR and the Census Bureau's National Crime Victimization Survey (NCVS). However, in contrast to UCR, NIBRS allows for the disaggregation of crime into specific categories that results in more accurate valuations on the cost of crime (<https://www.fbi.gov/services/cjis/ucr/nibrs>). NCVS is a survey, and thus is not meant as an exhaustive quantification of reported crime, and does not record certain crimes, such as homicides, and crimes for those under aged 12 (https://www.ncjrs.gov/ovc_archives/ncvrw/2017/images/en_artwork/Fact_Sheets/2017NCVRW_CrimeAndVictimization_508.pdf).

²⁶ The following LEAs report to NIBRS at least once during the study period: Barboursville Police Department (BPD), Cabell County Sheriff's Office (CCSO), Department of Natural Resources: Cabell County, Huntington Drug and Violent Crime Task Force, Huntington Police Department (HPD), Marshall University, Milton Police Department (MPD), State Fire Marshall, State Police: Huntington (SPH). LEAs with incomplete data in NIBRS include: CCSO, HPD, Marshall University, MPD, and SPH.

²⁷ Huntington Police Department data obtained from: HUNT_01718156, and HUNT_01515584. Cabell County Sheriff's Office counts obtained from: CCDS_0081519, CCDS_0081523, CCDS_0081527, CCDS_0081531, CCDS_0081533.

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and 2012. Years 2011 and 2013 include HPD and BPD data only. From 2014-2018, I use data from the HPD, BPD, and CCSO.²⁸

23. I adjust the number of crimes identified in the NIBRS data and individual LEAs to estimate crimes attributable to prescription opioids in three steps. First, the percent of all crimes in each category that can be attributable to drugs (opioids and non-opioids) is taken from U.S. DOJ National Drug Intelligence Center (NDIC).²⁹ These estimates are applied each year. One crime category is titled “Drug Crimes.” I assume that 100% of Drug Crimes are due to drugs.

24. Second, the share of drug-related crimes that are opioid-related is estimated following the methodology in Florence *et al.*³⁰ I use information on the share of items or seizures from law enforcement operations in Cabell County that contained opioids as reported by the National Forensic Laboratory Information Service (NFLIS). Table C.IV.1 reports these adjustments.

25. Third, the percent of opioid-related crimes that are attributable to prescription opioid sales is approximated using the rate of OUD attributed to prescription sales and distribution as reported in Table 4 of my Report.

26. Combining the above inputs yields an estimate of the number of crimes occurring in the Cabell Huntington Community that are attributable to the sales and distribution of prescription opioids. Table C.IV.2 presents these numbers by type of crime.

²⁸ In years with complete NIBRS data (2006-2010), HPD and CCSO account for 70% - 77% of crime counts. Because of my reliance on only these two LEAs in 2011, 2013, 2014-2018, my crime estimates are very conservative.

²⁹ United States Department of Justice, National Drug Intelligence Center, “The Economic Impact of Illicit Drug Use on American Society,” 2011. In Table 1.7 of Appendix A, the report assesses the impact of illicit drug use on criminal activity in two components. The first is *instrumental offenses*, where the crime was committed to obtain, or otherwise directly due to drugs. An example of this is theft that occurs for the specific purpose of supporting a drug habit. The second component is *related offenses*, where the crime may or may not have occurred in the absence of drugs, but drugs likely precipitated the event; for example, a violent crime precipitated by the disinhibiting properties of an illicit drug. The report attributes 10% of the *related offenses* as drug-related, and I do so as well. Using the figures from Table 1.7, for example, for murder, the share of this crime due to drugs is calculated as $(117+51.6)/4310 = 3.9\%$. Note that we calculate these shares using 2002 data, as per the report, but apply these to all years due to the lack of updated data availability.

³⁰ C.S. Florence, *et al.*, “The Economic Burden of Prescription Opioid Overdose, Abuse and Dependence in the United States, 2013,” *Medical Care*, 54(10), 2016, pp. 901-906 (hereafter Florence, *et al.*).

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Table C.IV.1
Opioid Reported Crime Events for Drug Crimes in Cabell County
2006-2018

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
[1] Count of opioids reported	1,807	1,807	1,507	3,409	2,927	3,291	3,400	4,106	3,317	2,504	1,861	1,609	1,906
[2] Count of substances tested	10,261	10,261	6,792	10,280	9,123	9,625	9,765	9,285	7,186	5,344	4,071	4,259	5,532
[3] Opioids share of substances tested	17.6%	17.6%	22.2%	33.2%	32.1%	34.2%	34.8%	44.2%	46.2%	46.9%	45.7%	37.8%	34.5%

Notes and Sources

[1] and [2] Source: Counts for drugs identified by WV forensic laboratories to the National Forensic Laboratory Information System (NFLIS). U.S. Drug Enforcement Administration, Diversion Control Division. 2008-2017. Table 2: State Counts for the most frequently identified drugs. Retrieved from the NFLIS Public Resource Library (<https://www.nflis.dea/diversion.usdoj.gov/Resources/NFLISPublicResourceLibrary.aspx>). 2006 data unavailable - set equal to 2007

[3] = [1] / [2]

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Table C.IV.2
Crimes Attributable to Prescription Opioid Sales and Distribution
in Cabell Huntington Community
2006-2018

Category of Offense	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
[1] Aggravated Assault	1.23	1.24	1.33	2.15	1.12	1.39	2.00	1.87	2.61	2.25	3.84	3.52	2.57	27.13
[2] All Other Offenses	0.19	0.14	0.23	0.25	0.29	42.22	0.14	43.35	64.10	52.95	96.05	54.01	46.80	400.72
[3] Arson	0.03	0.09	0.07	0.10	0.11	0.10	0.31	0.12	0.21	0.24	0.14	0.08	0.07	1.67
[4] Burglary	91.57	85.11	98.60	152.24	109.41	110.45	136.80	140.17	168.93	145.41	137.50	77.84	61.06	1,515.10
[5] Curfew/Loitering/Vagrancy	-	-	-	-	-	-	-	-	-	-	-	-	-	-
[6] Disorderly Conduct	-	-	-	-	-	-	-	-	-	-	-	-	-	-
[7] Driving Under the Influence	-	-	-	-	-	4.84	-	5.66	5.37	7.29	7.36	4.72	3.81	39.06
[8] Drug Crimes	108.14	93.91	117.93	215.90	172.54	84.75	168.86	112.87	238.05	194.33	239.54	323.31	342.82	2,412.97
[9] Drunkenness	-	-	-	-	-	3.22	-	2.41	2.86	4.77	3.19	1.72	1.13	19.30
[10] Embezzlement	1.03	1.09	1.35	1.79	1.41	0.94	1.70	1.32	1.47	1.59	1.13	0.82	0.55	16.19
[11] Family and Children	-	-	-	-	-	-	-	0.11	0.38	0.06	0.59	0.32	0.44	1.90
[12] Forcible Rape	0.57	0.52	0.74	0.91	0.70	0.65	0.60	0.83	0.95	0.66	0.75	0.99	0.99	9.86
[13] Forgery and Fraud	24.98	26.42	32.67	46.52	44.01	29.44	44.90	37.67	46.49	51.85	46.57	31.12	25.71	488.37
[14] Gambling Offenses	-	-	-	-	-	-	-	-	-	-	-	-	-	-
[15] Human Trafficking	-	-	-	-	-	-	-	-	-	-	-	-	-	-
[16] Larceny-theft	202.09	185.98	225.97	333.98	262.63	206.14	309.86	288.30	368.12	319.70	303.48	192.11	202.12	3,400.47
[17] Liquor Laws	-	-	-	-	-	0.20	-	0.17	0.29	0.86	0.43	0.35	0.06	2.36
[18] Motor Vehicle Theft	18.48	18.44	19.38	22.09	15.67	12.99	16.83	16.49	25.16	17.81	18.08	17.81	13.58	232.81
[19] Murder	0.01	0.03	0.06	0.05	0.02	0.04	0.03	0.08	0.07	0.05	0.18	0.21	0.14	0.96
[20] Other Assaults	11.73	11.28	14.80	22.09	17.41	13.53	18.10	14.63	13.73	14.22	17.62	11.10	8.73	188.98
[21] Prostitution	2.02	4.48	5.72	10.39	4.02	9.25	7.18	7.00	7.02	10.50	5.17	5.24	1.21	79.19
[22] Robbery	10.47	9.97	13.05	18.44	15.65	17.27	14.63	15.53	15.45	18.76	17.53	13.77	9.01	189.52
[23] Sex Offenses	0.08	0.10	0.13	0.16	0.15	0.17	0.22	0.15	0.15	0.14	0.15	0.08	0.11	1.77
[24] Stolen Property	0.61	0.90	0.56	1.04	1.60	0.24	0.95	2.02	2.98	2.50	4.54	3.42	2.89	24.25
[25] Vandalism	8.66	7.53	10.60	14.27	10.53	7.66	10.56	8.97	11.83	13.17	13.02	6.61	5.94	129.35
[26] Weapons	0.26	0.20	0.25	0.52	0.30	0.10	0.43	0.54	1.58	1.59	0.79	0.68	0.57	7.82
[27] Total Offenses due to Prescription Opioids	482	447	543	843	658	546	734	700	978	861	918	750	730	9,190

Notes and Sources

[1] - [26] = (Crime - Q - OPs) * (% Rx OPs)

[27] = Σ [1:26]

Confidential**IV.2. Valuation of Criminal Offenses Attributable to Prescription Opioid Sales and Distribution**

27. The main sources of monetary estimates are McCollister, *et al.* (2010) and Miller and Bhattacharya (2013).³¹ The authors estimate the cost of crime by offense category using two methods: cost-of-illness and jury compensation. The cost-of-illness approach identifies a comprehensive list of costs imposed by crime on society, including property loss, medical costs, lost productivity, crime prevention expenses, pain and suffering. These costs are then attributed to different crime categories (theft, arson, etc.) to estimate a “per-offense” unit cost by type of criminal activity. The jury-compensation approach is an estimation method for the intangible costs of crime, such as pain and suffering, and adjusted risk of homicide,³² derived from data on jury awards received by crime victims.³³ These two methodologies allow for the disaggregation of the unit cost of a given crime into direct, implicit, and intangible costs and are widely used in the crime cost literature.³⁴

28. I match the offense categories on criminal activity attributable to prescription opioid sales and distribution to the per-offense cost estimates from the literature.³⁵ Cost estimates per offense are not available for all crimes (such as disorderly conduct). In these cases, I assign no costs.

³¹ K.E. McCollister, M.T. French, and H. Fang, “The Cost of Crime to Society: New Crime-Specific Estimates for Policy and Program Evaluation,” *Drug and Alcohol Dependence*, 108(1), 2010, pp. 98-109 (hereafter McCollister *et al.*). T. Miller and S. Bhattacharya, “Incidence and Cost of Carbon Monoxide Poisoning for All Ages, Pool and Spa Submersions for Ages 0– 14, and Lead Poisoning for Ages 0-4,” 2013, Table 20 (https://www.cpsc.gov/s3fs-public/pdfs/IncidenceandCostofCarbonMonoxidePoisoningPoolandSpaSubmersionandLeadPosioning_0.pdf).

³² Homicide is sometimes the result of criminal activity. To account for this, the valuation of crime costs includes a risk of homicide component that is divided into a tangible cost and an intangible cost. Within tangible costs, risk of homicide is included in Crime Victim Costs, and entails mean present value of the victim’s expected lifetime earnings. Within intangible costs, Adjusted Risk of Homicide captures the intangible costs of homicide using the mean Value of a Statistical life (VSL). See McCollister *et al.*, p 103

³³ M.A. Cohen, “Pain, Suffering, and Jury Awards: A Study of the Cost of Crime to Victims,” *Law & Society Review*, 22(3), 1988, pp. 537-555.

³⁴ Examples of these approaches are D.A. Anderson, “The Cost of Crime,” *Foundations and Trends® in Microeconomics*, 7(3), 2011, pp. 209-265 and T.R. Miller, M.A. Cohen, and D. Hendrie, “Non-Economic Damages Due to Physical and Sexual Assault: Estimates from Civil Jury Awards,” *Forensic Science and Criminology*, 2(1), 2017, pp. 1-10.

³⁵ Some of these categories do not match one to one, or there are difficulties in finding per-offense costs for some crimes. I specify the sources for each crime category in the Quantitative Backup. In particular, I do not have the adjusted risk-of-homicide crime costs for crimes not available in McCollister, *et al.* Other assumptions include the use of the sexual assault per-offense cost to crimes in the data categorized as forcible rape.

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29. Finally, I multiply the crime counts due to prescription opioid sales and distribution in each crime category by the corresponding per-offense cost estimate, which yields the total crime costs broken into direct, indirect, and intangible costs.

30. Table C.IV.3 identifies the direct, implicit, and intangible costs associated with each category of offense, and the sources for those values. Total costs by category of offense appear in Table C.IV.4. The sum of these costs by year for Cabell Huntington Community appear in Table C.IV.5 and in my Report, Table 8.

**Table C.IV.3
Summary of Costs by Offense**

Category of Offense	Direct Cost/Offense		Implicit Cost/Offense	Intangible Costs/Offense		Total All Costs
	Crime Victim Cost	Criminal Justice Cost	Crime Career Cost	Pain and Suffering	Adjusted Risk of Homicide	
[1] Aggravated Assault	\$8,700	\$8,641	\$2,126	\$13,435	\$81,588	\$114,490
[2] All Other Offenses	\$70	\$229	\$92	N/A	N/A	\$391
[3] Arson	\$11,452	\$4,392	\$584	\$0	\$5,133	\$21,561
[4] Burglary	\$1,362	\$4,127	\$681	\$0	\$321	\$6,491
[5] Curfew/Loitering/Vagrancy	\$70	\$1,093	\$381			\$1,544
[6] Disorderly Conduct	\$70	\$1,093	\$381			\$1,544
[7] Driving Under the Influence	\$19	\$415	\$145			\$579
[8] Drug Crimes	\$4,490	\$3,202	\$1,118	\$0	N/A	\$8,810
[9] Drunkenness	\$70	\$1,093	\$381			\$1,544
[10] Embezzlement	\$0	\$4,820	\$660	N/A	N/A	\$5,480
[11] Family and Children						\$0
[12] Forcible Rape	\$5,556	\$26,479	\$9,212	\$198,212	\$1,430	\$240,889
[13] Forgery and Fraud	\$0	\$4,605	\$660	N/A	N/A	\$5,265
[14] Gambling Offenses	\$70	\$229	\$80			\$379
[15] Human Trafficking						\$0
[16] Larceny-theft	\$480	\$2,879	\$163	\$0	\$10	\$3,532
[17] Liquor Laws	\$70	\$1,093	\$381	\$0		\$1,544
[18] Motor Vehicle Theft	\$6,114	\$3,867	\$553	\$0	\$262	\$10,796
[19] Murder	\$737,517	\$392,352	\$148,555	\$8,442,000	\$0	\$9,720,424
[20] Other Assaults	\$3,425	\$5,655	\$1,878	\$13,069	N/A	\$24,027
[21] Prostitution	\$70	\$229	\$80	\$0	N/A	\$379
[22] Robbery	\$3,299	\$13,827	\$4,272	\$4,976	\$17,599	\$43,973
[23] Sex Offenses	\$5,686	\$24,679	\$9,517	\$89,784	N/A	\$129,666
[24] Stolen Property	\$0	\$6,842	\$1,132	N/A	N/A	\$7,974
[25] Vandalism	\$0	\$4,160	\$701	N/A	N/A	\$4,861
[26] Weapons	\$70	\$2,289	\$799	\$0	N/A	\$3,158

Notes and Sources:

[1], [3], [4], [10] - [13], [16], [18], [19], [22], [24] and [25] are in 2008 dollars. Costs are from McCollister *et al.* Tables 3 & 4

[2], [5] - [9], [11], [14], [15], [17], [20], [21], [23], and [26] are in 2010 dollars. Costs are from Miller and Bhattacharya Table 20, except for Adjusted Risk of Homicide which all come from McCollister, *et al.* I treat Medical costs, work, property damage and public services as Crime Victim Costs. Criminal Justice Costs are from Adjudication and Sanctioning. Implicit costs are Perpetrator Work Loss. Intangible costs, under Pain and Suffering, come from Mental Health Costs and Quality of Life costs.

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Table C.IV.4
Valuation of Crimes Attributable to the Sales and Distribution of Prescription Opioids in
Cabell Huntington Community by Offense
2006-2018

Category of Offense	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
[1] Aggravated Assault	\$140,495	\$142,259	\$152,828	\$246,630	\$128,615	\$159,090	\$229,377	\$213,847	\$298,573	\$257,392	\$440,081	\$402,701	\$293,924	\$3,105,811
[2] All Other Offenses	\$75	\$56	\$90	\$99	\$112	\$16,506	\$54	\$16,948	\$25,063	\$20,705	\$37,555	\$21,118	\$18,298	\$156,681
[3] Arson	\$724	\$1,980	\$1,418	\$2,119	\$2,475	\$2,073	\$6,706	\$2,567	\$4,565	\$5,199	\$2,953	\$1,620	\$1,503	\$35,901
[4] Burglary	\$594,408	\$552,422	\$640,034	\$988,209	\$710,156	\$716,917	\$887,982	\$909,837	\$1,096,543	\$943,869	\$892,538	\$505,250	\$396,320	\$9,834,486
[5] Curfew/Loitering/Vagrancy	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
[6] Disorderly Conduct	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
[7] Driving Under the Influence	\$0	\$0	\$0	\$0	\$0	\$2,805	\$0	\$3,280	\$3,110	\$4,223	\$4,260	\$2,733	\$2,206	\$22,616
[8] Drug Crimes	\$952,740	\$827,387	\$1,038,945	\$1,902,096	\$1,520,078	\$746,660	\$1,487,694	\$994,396	\$2,097,226	\$1,712,069	\$2,110,338	\$2,848,340	\$3,020,285	\$21,258,255
[9] Drunkenness	\$0	\$0	\$0	\$0	\$0	\$4,971	\$0	\$3,716	\$4,419	\$7,358	\$4,925	\$2,662	\$1,747	\$29,797
[10] Embezzlement	\$5,638	\$5,971	\$7,412	\$9,812	\$7,742	\$5,178	\$9,309	\$7,216	\$8,041	\$8,732	\$6,199	\$4,484	\$3,011	\$88,745
[11] Family and Children	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
[12] Forcible Rape	\$137,558	\$126,120	\$178,584	\$218,785	\$167,902	\$156,593	\$143,959	\$199,524	\$227,895	\$159,133	\$181,778	\$239,420	\$237,858	\$2,375,107
[13] Forgery and Fraud	\$131,516	\$139,109	\$172,027	\$244,902	\$231,734	\$155,014	\$236,405	\$198,356	\$244,785	\$272,994	\$245,200	\$163,864	\$135,340	\$2,571,246
[14] Gambling Offenses	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
[15] Human Trafficking	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
[16] Larceny-theft	\$713,766	\$656,889	\$798,131	\$1,179,608	\$927,607	\$728,099	\$1,094,410	\$1,018,268	\$1,300,200	\$1,129,178	\$1,071,904	\$678,528	\$713,875	\$12,010,462
[17] Liquor Laws	\$0	\$0	\$0	\$0	\$0	\$310	\$0	\$256	\$450	\$1,332	\$660	\$544	\$92	\$3,644
[18] Motor Vehicle Theft	\$199,513	\$199,107	\$209,173	\$238,525	\$169,158	\$140,235	\$181,746	\$178,034	\$271,614	\$192,292	\$195,145	\$192,270	\$146,639	\$2,513,452
[19] Murder	\$65,271	\$261,139	\$583,443	\$498,306	\$239,008	\$382,132	\$248,395	\$788,951	\$632,993	\$468,674	\$1,774,362	\$2,069,231	\$1,354,368	\$9,366,274
[20] Other Assaults	\$281,851	\$271,135	\$355,557	\$530,744	\$418,416	\$325,115	\$434,849	\$351,530	\$329,917	\$341,597	\$423,359	\$266,818	\$209,845	\$4,540,732
[21] Prostitution	\$765	\$1,697	\$2,166	\$3,936	\$1,523	\$3,505	\$2,722	\$2,654	\$2,661	\$3,981	\$1,959	\$1,985	\$460	\$30,015
[22] Robbery	\$460,382	\$438,230	\$573,689	\$810,765	\$688,169	\$759,548	\$643,252	\$682,824	\$679,414	\$825,100	\$770,863	\$605,533	\$396,112	\$8,333,882
[23] Sex Offenses	\$10,517	\$13,044	\$16,922	\$20,876	\$19,641	\$21,756	\$28,417	\$18,815	\$18,869	\$17,621	\$19,537	\$10,199	\$13,821	\$230,037
[24] Stolen Property	\$4,825	\$7,156	\$4,462	\$8,257	\$12,795	\$1,948	\$7,599	\$16,090	\$23,802	\$19,913	\$36,187	\$27,306	\$23,018	\$193,360
[25] Vandalism	\$42,111	\$36,597	\$51,503	\$69,388	\$51,186	\$37,255	\$51,326	\$43,605	\$57,514	\$64,002	\$63,279	\$32,110	\$28,884	\$628,759
[26] Weapons	\$818	\$626	\$799	\$1,653	\$940	\$313	\$1,374	\$1,706	\$4,978	\$5,030	\$2,508	\$2,154	\$1,803	\$24,702
[27] Total	\$3,742,975	\$3,680,925	\$4,787,182	\$6,974,711	\$5,297,257	\$4,366,024	\$5,695,575	\$5,652,420	\$7,332,634	\$6,460,394	\$8,285,589	\$8,078,870	\$6,999,408	\$77,353,963

Notes and Sources

[1] - [26] (Crime - Q - Rx Op) * (Crime - \$ per Offense)

[27] = Σ [1-26]

Table C.IV.5
Total Valuation of Crimes Attributable to the Sales and Distribution of Prescription
Opioids in the Cabell Huntington Community
2006-2018

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
[1] Crime events attributable to prescription opioids	482.1	447.4	543.4	842.9	657.6	545.6	734.1	700.2	977.8	860.7	917.7	749.8	730.3	9,189.8
Costs for crimes attributable to prescription opioids (\$millions)	\$3.7	\$3.7	\$4.8	\$7.0	\$5.3	\$4.4	\$5.7	\$5.7	\$7.3	\$6.5	\$8.3	\$8.1	\$7.0	\$77.4

Notes and Sources

Tables C.IV.1 - C.IV.4

Confidential**IV.3. Residential Property Value Lost Because of Crime Attributable to the Sales and Distribution of Prescription Opioid**

31. Based on empirical research in urban economics and public finance, I quantify the connection between *one* of the mechanisms and *one* of the outcomes by which the opioid epidemic has degraded neighborhoods – the effect of opioid-related crime on property values. By only tracking one mechanism and one outcome, my accounting of this cost is likely to be a vast understatement of the harm caused by opioids on the fabric of a community.³⁶

32. Analysis of the economic harm to property values proceeds differently than the other harm categories because the property-value harm is not an annual effect; it is a point-in-time effect. For crimes over the period 2006-2018, the methodology (Sections IV.2 and IV.3) for valuing the harms involved counting the number of crimes each year and valuing them. In terms of property values, crimes anticipated in the future depress property values now. This loss should be measured one time, as of 2019.³⁷

33. It is worth emphasizing that it is the expectation of future events, here crimes, that is capitalized into current home values due to decreased demand for housing. The crimes occur in the future, but the harm is felt now.

34. Three main inputs feed into this calculation of loss: residential property values; economic research on the impact of crime on property values; and projections of future crime rates due to prescription opioids. These will be combined within the standard economic approach to property valuation to quantify the degree to which crime is capitalized into (lowering) home values.

³⁶ Cook, p. 15, gives one expression to this understatement: “Without a doubt the great crime reduction of the 1990s gets some of the credit for the urban renaissance that occurred in one large city after another beginning in that period, with New York being the most notable case in point. (reference omitted.) (President Bill Clinton would not have wanted his office in Harlem back in 1980.) None of the available estimates of the cost of crime successfully captures this dynamic, transformative possibility.” See P. J. Cook, *Assessing Urban Crime and Its Control: An Overview*, National Bureau of Economic Research Working Paper 13781, 2008. Albouy *et al.*, p. 26, agrees, noting that the value of other forms of public capital, such as public transit, may be similarly reduced by crime. See D. Albouy, P. Christensen, and I. Sarmiento-Barbieri, *Unlocking Amenities: Estimating Public-Good Complementarity*, National Bureau of Economic Research Working Paper 25107, 2019.

³⁷ Home value, like other forms of wealth, is a stock, not a flow.

ConfidentialValue of Residential Real Estate in the Cabell Huntington Community

35. The first input needed is the value of residential property in the Cabell Huntington Community. Data from the West Virginia State Tax Department indicates that the total assessed value of residential property (owned and rented) in Cabell County in 2019 was \$2.87 billion.³⁸ (This value includes the part of the City of Huntington in Cabell County but does not include the Wayne County part of the city.) In Cabell County, market value of a property exceeds the assessed value. Based on data from the West Virginia Assessment Ratio Study for 2019, I calculate that the average ratio of assessed to sales value in Cabell County was 56%, meaning that for a typical property, assessed value was 56% of market value.³⁹ Converting assessed value to market value requires dividing the assessed value by .56 to determine that the market value of residential property in Cabell County for 2019 is \$5.13 billion.

Crime and Property Values

36. The second input is the effect of crime on property values. Linden and Rockoff emphasize that crime is a local issue, with the majority of both violent and nonviolent offenses taking place less than one mile from victims' homes.⁴⁰ Local crime is known to have a negative effect on property values, a finding supported by many economic studies covering different geographic areas, time periods, and types of crime. Economists have studied overall crime rates in small areas (such as a city), and the effects of particular types of crime. Two papers report the effect of the risk of crime associated with location of a convicted sexual offender on home

³⁸ Specifically, "the total assessed values of residential properties (Classes 2 and 4), the total homestead exemptions claimed, and the net assessed value-by year" for Cabell County (not just the City of Huntington, but not including the part of the City of Huntington in Wayne County). Class 2 and 4 mean this: "Class 2, owner-occupied property, including any adjoining empty lot (a separate parcel, used as a side yard, for example). Class 4, non-owner-occupied property, such as rental property (occupied) or a vacant house on a lot. This is also 'residential' but a different class (4)." State Tax Commissioner, Property Tax Division, "West Virginia Assessment Ratio Study, Tax Year 2019," 2019 (<https://tax.wv.gov/Documents/Reports/2019/AssessmentRatioStudy.2019.pdf>) (hereafter WV Tax Assessment). See Total Assessed value of residential properties (Classes 2 and 4), the total homestead exemptions claimed, and the net assessed value-by year, Cabell County. WV State Tax Department (cabell-asmt.xls) showing assessed value of property of Cabell County = \$2,867,296,210.

³⁹ Table III.A from the WV Tax Assessment reports that for Cabell County the ratio of assessed to market value was 55 for Class 2 property and 62 for Class 4. I used the volume of sales reported for each class in 2019 to construct a weighted average of 56. The volume of sales in Class 2 for Cabell County was 589 and 74 for Class 4 $[(589*55 + 74*62)/(589 + 74) = 55.78]$.

⁴⁰ L. Linden and J. E. Rockoff, "Estimates of the Impact of Crime Risk on Property Values from Megan's Laws," *The American Economic Review*, June 2008, 98(3), pp. 1103-1127 at p. 1103.

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values, both finding negative effects in neighborhoods close to the offender's placement.⁴¹ Once the offender relocates, property values rebound supporting the causal interpretation of crime on home value. The sex-offender studies also make clear that it is the risk of future crimes that drive property values.⁴²

37. Pope and Pope (2012), in a national study of 3,000 urban zip codes during the 1990s, use variation in the large decline in crime rates to estimate the effect of crime on property values.⁴³ They report their results in the form of an elasticity (percentage responsiveness of property value to a percentage change in crime) which can be applied to home values in Cabell County. According to Pope and Pope (2012), a 1% decline in crime increases home values by between 0.15% and 0.35%. For my estimates, I will use the midpoint of these values, 0.25%, as the percentage point increase in property value in response to a one percentage point reduction in crime.

Eliminating Risk of Future Crimes Due to Prescription Opioids

38. The third input is an estimate of how much crime would be reduced if crimes due to sales and distribution of prescription opioids were eliminated. Over the 2006-2018 period, the share of total crimes attributable to prescription opioids was 7.2%.⁴⁴ I assume for my calculations that this same share applies to future crimes. In other words, I assume that the expected share of crimes going forward due to prescription opioids is 7.2%.⁴⁵

Results: Risk of Crime and Loss of Property Value

39. The three inputs described above can be combined to determine the loss from the risk of prescription opioid-caused crime capitalized in residential property value in 2019.

⁴¹ L. Linden and J.E. Rockoff, *op. cit.* See also J.C. Pope, "Fear of Crime and Housing Prices: Household Reactions to Sex Offender Registries," *Journal of Urban Economics*, 2008, 64(3), pp. 601-614.

⁴² See Pope, *op. cit.*, p. 603, for an explicit statement that it is the risk of future crimes that drive property values.

⁴³ D.G. Pope and J.C. Pope, "Crime and property values: Evidence from the 1990s crime drop," *Regional Science and Urban Economics*, 2012, 42, pp. 177-188.

⁴⁴ The total number of crimes due to the sales and distribution of prescription opioids is 9,179, see Table C.IV.2 above. Table C.IV.2 contains the distribution of these crimes by type of offense. The total number of crimes in the Cabell Huntington Community over 2006-2018 is 128,376, see Quantitative Backup, Sheet Crime Q, Row [27]

⁴⁵ With this assumption, expectations about the future are set by experience. This share would be higher if potential home buyers expect the rates for other crimes to grow more slowly/fall faster than the rates for crimes due to the sales and distribution of prescription opioids, and conversely.

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$$\begin{aligned}\text{Loss} &= (\text{2019 Property Value}) * \\ &\quad (\% \text{ reduction in crime removing crimes due to prescription opioids}) * \\ &\quad (\text{elasticity of property value with respect to crime}) \\ \text{Loss} &= (\$5.13 \text{ billion}) * (.072) * (.25) \\ &= \$92.3 \text{ million}\end{aligned}$$

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Section V

Child Maltreatment

40. In Section V.1, I describe the basis for the quantification of maltreated children over time in Cabell County attributable to the sales and distribution of prescription opioid. In Section V.2, I describe the methodology used to value the costs of maltreatment.

V.1. Children Maltreated in Cabell County

41. The number of children maltreated attributable to prescription opioid sales and distribution is obtained in five steps, which are displayed in Table C.V.1. All data is obtained from the HHS's Administration for Children and Families (ACF).⁴⁶ First, I obtain the number of unique and the number first-time maltreated children in West Virginia for 2006-2018, and I calculate the ratio of first-time victims to unique victims. This is row [3] of the table. Second, I obtain the counts of unique maltreatment victims with a drug abuse caregiver risk factor, represented in row [4]. Note that there are several years for which this data is unavailable,⁴⁷ and that these counts are annual unique number of victims, which might be present in multiple years. To address the potential-double counting, I apply the ratio calculated in [3] to the count of unique maltreatment victims with a drug abuse factor [4]. This yields row [5], which is an estimated number of first-time maltreatment victims with a drug abuse risk factor.⁴⁸

42. Third, I take the product of the share of West Virginian children in Cabell County, row [8] and row [5] to estimate the number of first-time maltreated victims with a care giver drug abuse risk factor living in Cabell County. Fourth, I multiply these county-level counts by the

⁴⁶ Administration for Children and Families (<https://www.acf.hhs.gov>) is a division in the Department of Health and Human Services which collects detailed annual information from states on child maltreatment and produces yearly reports on state level incidents of maltreatment, overall and broken out by category, as well as information on characteristics of victims, number of fatalities, and services to prevent maltreatment, among other metrics. The statistics on child maltreatment are derived from data collected by child protective agencies through the National Child Abuse and Neglect Data System (NCANDS). I note that there is a notable increase in the share of maltreatment victims attributable to opioids in 2014. This jump could be for the following reasons: Years 2014-2016 saw better reporting of the number of victims with the drug abuse caregiver risk factor in the ACF (ACF Report 2016, p. 21). In addition, on July 1, 2014, West Virginia launched a more centralized child abuse and neglect intake unit, which led to an increase in referrals (ACF Report 2016, p. 226).

⁴⁷ Missing years include 2006-2009, 2013, and 2015. I assign years 2006-2009 the count for 2010. For 2013 and 2015, I use the preceding year.

⁴⁸ I use unique counts for 2006, and these estimated first-time counts for 2007 – 2018.

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ratio of opioids in drug seizures, row [9] to estimate the share of maltreatment cases due to opioids. Finally, to derive the incidents of maltreatment related to prescription opioids, I multiply by the ratio of opioid use disorder (OUD) in the Cabell Huntington Community as in row [10]. This leads to row [11], the number of maltreated children in Cabell County due to prescription opioids.

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Table C.V.1
Maltreatment Victims in Cabell County due to Sales and Distribution of Prescription Opioids
2006-2018

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
[1] First-Time Maltreatment Victims	4,471	3,819	3,472	3,393	2,762	2,960	3,540	3,795	3,984	4,118	5,192	5,743	5,563	52,812
[2] Unique Maltreatment Victims	7,213	6,143	5,300	4,978	3,961	4,000	4,591	4,695	4,962	4,857	5,938	6,496	6,496	69,630
[3] Percentage of Unique Maltreatment Victims that are First- Time	62.0%	62.2%	65.5%	68.2%	69.7%	74.0%	77.1%	80.8%	80.3%	84.8%	87.4%	88.4%	85.6%	
[4] Unique Maltreatment Victims with a Drug Abuse Caregiver Risk Factor, WV	334	334	334	334	334	335	388	388	357	357	3107	3655	3968	14,225
[5] Estimated First-Time Maltreatment Victims with a Drug Abuse Risk Factor, WV	207	208	219	228	233	248	299	314	287	303	2717	3231	3398	11,890
[6] Children in WV	389,071	387,381	386,158	386,449	387,224	385,283	384,030	381,678	380,798	378,231	374,348	369,122	364,160	4,953,933
[7] Children in Cabell county	19,064	18,982	18,922	18,936	18,889	19,483	19,485	19,409	19,477	19,737	19,410	18,826	18,444	249,064
[8] Share of WV children in Cabell county	4.9%	4.9%	4.9%	4.9%	4.9%	5.1%	5.1%	5.1%	5.1%	5.2%	5.2%	5.1%	5.1%	
[9] Share attributed to opioids	17.6%	17.6%	22.2%	33.2%	32.1%	34.2%	34.8%	44.2%	46.2%	46.9%	45.7%	37.8%	34.5%	
[10] Share attributed to prescription opioids	97.5%	97.5%	98.8%	98.8%	98.0%	98.0%	93.8%	93.8%	90.2%	87.7%	85.1%	84.7%	86.1%	
[11] Maltreatment victims attributed to prescription opioids in Cabell county	3	2	2	4	4	4	5	7	6	6	55	53	51	201

Notes and Sources

[1] - [2]: Source: Data come from Children's Bureau of the U.S. Department of Human and Health Services, available here: <https://www.acf.hhs.gov/cb/research-data-technology/statistics-research/>
[3] = [1] / [2]

[4] Data come from the Children's Bureau of the U.S. DHHS, as per [1] and [2]. Data were unavailable for 2006- 2009, 2013, and 2015; I assume 2006 - 2009 are equal to 2010. 2013 and 2015 are set equal to the preceeding year. 2010 data came from table 3-18 of 2010 report. 2011-2012 from table 3-12. 2014 data from table 3-9. 2016-2018 data from table 2-10 in 2018 report.

[5] = [3] * [4]

[6] All children counts come from reports used for [1], [2], and [4]. Data come from table 3-1 of these annual reports.

[7] American Community Survey 1- Year Estimates, table S0101. data is unavailable pre 2010, so I estimate is assuming the same share of West Virginian children residing in Cabell County for 2010.

[8] = [7] / [6]. Data for 2006 - 2009 set equal to 2010

[9] C.IV.1. Row [3]

[10] Source: Morbidity - Q, Row [6]

[11] = [5] * [8] * [9] * [10]. For 2006, I use unique victims with a drug abuse risk factor.

V.2. Calculation of Costs of Child Maltreatment for Cabell County

43. Fang, *et al.* (2012) estimates an average lifetime cost per victim of nonfatal child maltreatment of \$210,012 in 2010 dollars.⁴⁹ This lifetime cost includes costs of childhood health

⁴⁹ X. Fang, *et al.*, "The Economic Burden of Child Maltreatment in the United States and Implications for Prevention," *Child Abuse & Neglect*, 36, 2012, pp. 156-165.

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care, adult medical costs, productivity losses, child welfare costs, criminal justice costs and special education costs. The method for counting maltreated children outlined above is consistent with Fang, *et al.*'s methodology in that it uses the same source for the incidence of maltreatment, the HHS Annual Report on Child Maltreatment – counts of victims of maltreatment.⁵⁰

44. I estimate the social costs associated with child maltreatment in two categories: productivity and special education.

45. Childhood maltreatment has adverse effects on economic outcomes in adulthood. Currie & Widom (2010)⁵¹ tracks matched cohorts from an earlier study of childhood maltreatment into adulthood.⁵² The authors find that adults who experienced validated and substantiated maltreatment as children earn approximately \$6,500 less annually (2003 dollars) and are 14 percentage points less likely to be employed at middle age (mean age 41).

46. To keep the calculations simple, I sum the total earnings lost per maltreated child with no discounting and no adjustments for inflation or productivity growth. If on average a person works 44 years (from age 21 through 64) and loses \$6,500 per year, the total lost earnings over a lifetime is \$286,000.

47. In addition to earnings differences, maltreated children are less likely to own assets (*e.g.*, stock, a vehicle, a home) in adulthood than children who did not experience maltreatment.⁵³ I do not attribute dollar values to these adverse events or include these differences in the cost of maltreatment.

48. In terms of excess special education costs, a study by Jonson-Reid, *et al.* (2004)⁵⁴ finds that maltreated children are 10.8 percentage points more likely to need special education services (*i.e.*, receive services for an educational disability) than children who are impoverished but not

⁵⁰ Children's Bureau, Office of the Administration for Children & Families, U.S. Department of Health and Human Services, "Child Maltreatment 2017," January 28, 2019 (<https://www.acf.hhs.gov/cb/research-data-technology/statistics-research/child-maltreatment>).

⁵¹ J. Currie and C.S. Widom, "Long-Term Consequences of Child Abuse and Neglect on Adult Economic Well-Being," *Child Maltreatment*, 15(2), 2010, pp. 111-120.

⁵² For one of the studies that Currie and Widom (*Ibid.*) update, see C.S. Widom, "The Cycle of Violence," *Science*, 244, 1989, pp. 160-166.

⁵³ Currie & Widom, *op. cit.*, Table 2.

⁵⁴ M. Jonson-Reid, *et al.*, "A Prospective Analysis of the Relationship Between Reported Child Maltreatment and Special Education Eligibility Among Poor Children," *Child Maltreatment*, 9(4), November 2004, pp. 381-394.

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maltreated (24.3% vs. 13.5%). This effect remains consistent after controlling for potential confounders.

49. Research shows that students needing special education services cost \$9,298 more per year than other students.⁵⁵ Students remain in special education on average approximately two years,⁵⁶ leading to a total incremental average cost per maltreated child of \$2,008.37 ($.108 * \$9,298 * 2$). This value is used for all years 2008-2017.

50. The total value of the increase in special education costs as well as productivity losses due to maltreatment cases attributable to opioid sales and distribution is shown in Table C.V.2. Total maltreatment costs due to prescription opioids are presented in Table 9 of my Report.

Table C.V.2
Maltreatment Costs in Cabell County due to Sales and Distribution of Prescription Opioids 2006-2018

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
[1] Productivity losses (\$000s)	\$286.0	\$286.0	\$286.0	\$286.0	\$286.0	\$286.0	\$286.0	\$286.0	\$286.0	\$286.0	\$286.0	\$286.0	\$286.0
[2] Special education costs (\$000s)	\$2.0	\$2.0	\$2.0	\$2.0	\$2.0	\$2.0	\$2.0	\$2.0	\$2.0	\$2.0	\$2.0	\$2.0	\$2.0
[3] Total social costs (\$000s)	\$288.0	\$288.0	\$288.0	\$288.0	\$288.0	\$288.0	\$288.0	\$288.0	\$288.0	\$288.0	\$288.0	\$288.0	\$288.0

Notes and Sources

[1] J. Currie and C.S. Widom, "Long-Term Consequences of Child Abuse and Neglect on Adult Economic Well-Being," *Child Maltreatment*, 15(2), 2010, pp. 111-120, find that maltreated children earn approximately \$6,500 less per year. I assume the average adult works 44 years. Thus the productivity loss is $(6,500) * (44) = \$286,000$.

[2] M. Jonson-Reid, et al., "A Prospective Analysis of the Relationship Between Reported Child Maltreatment and Special Education Eligibility Among Poor Children," *Child Maltreatment*, 9(4), November 2004, pp. 381-394, find that maltreated children are 10.8% more likely to require special education. Average cost per year of special education (\$9,298). A typical child receives 2 years of special education. This leads to $(0.108) * (9,298) * (2) = \$2,008$. See section V.2 for sources on these figures

[3] = [1] + [2]

51. The two cost categories above are not an exhaustive list of the social costs of childhood maltreatment. As an example of the effects of maltreatment on educational and developmental

⁵⁵ Chambers, *et al.*, *op. cit.* The National Center for Education Statistics, Digest of Education Statistics report that in 2014-2015, cost per pupil averaged \$11,445 with 13.2% of children receiving school-based special education services in 2015-16. Using these inputs, I determine that the average cost over all students is \$10,218 and that the cost for special education students is \$19,516 ($\$10,218 * 1.91$). I use the difference between these two numbers (\$9,298) as the additional special education cost incurred per school year. See National Center for Education Statistics, Table 236.15 for cost per pupil (https://nces.ed.gov/programs/digest/d17/tables/dt17_236.15.asp) and Table 204.30 for percent of total enrollment for children with disabilities (https://nces.ed.gov/programs/digest/d17/tables/dt17_204.30.asp).

⁵⁶ Holt, McGrath, and Herring, *op. cit.*; A.A. Scarborough and J.S. McCrae, "Maltreated Infants: Reported Eligibility for Part C and Later School-Age Special Education Services," *Topics in Early Childhood Special Education*, 28(2), 2008, pp. 75-89.

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outcomes, children who are maltreated complete fewer years of schooling,⁵⁷ have lower IQ scores in young adulthood,⁵⁸ and are significantly less likely to attend 4-year college,⁵⁹ than other children. Additionally, children who experience maltreatment have higher rates of substance misuse and depression in adulthood than other children.⁶⁰ Finally, there are direct costs associated with child welfare.⁶¹ Costs associated with these harms are not included here.

⁵⁷ Currie & Widom, *op. cit.*

⁵⁸ Currie & Widom, *op. cit.*

⁵⁹ J.P. Mersky and J. Topitzes, “Comparing Early Adult Outcomes of Maltreated and Non-Maltreated Children: A Prospective Longitudinal Investigation,” *Children and Youth Services Review*, 32, 2010, pp. 1086-1096.

⁶⁰ *Ibid.*; C.S. Widom, K. Dumont and S.J. Czaja, “A Prospective Investigation of Major Depressive Disorder and Comorbidity in Abused and Neglected Children Grown Up,” *Archives of General Psychiatry*, 64, 2007, pp. 49-56.

⁶¹ Fang, *et al.*, *op. cit.*